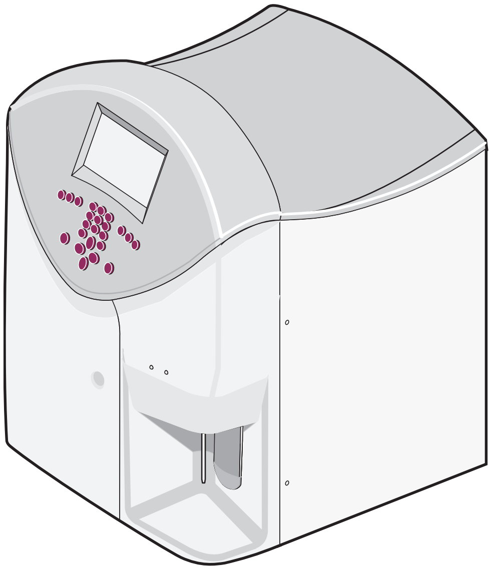
BECKMAN COULTER™ A^{C}•T™ 5diff
Hematology Analyzer

Service Manual



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COULTER CORPORATION
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REVISION STATUS

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The material in the revision B change pages was updated for software version 1.03 and for any hardware changes since revision A. The changes include updating the adjustment procedures for the bath assembly, HGB blank, RBC/PLT gain, WBC/BASO, motor current, thresholds, and the optical bench; updating the replacement procedures for the heater assembly, power supply, start switch, reagent syringes, count syringe, sample prove, waste syringe, 5diff syringe, flow-cell coax, optical bench lamp, diluent reservoir, and sample syringe; updating the procedure for testing and configuring the bar-code reader; updating the parts lists; updating the tubing lists and associated circuit connections; adding procedures for balancing the WBC count, setting the diff$^+$/diff$^-$ thresholds, and replacing the new Main card; and adding information on the LX300 + printer.

Changes were made on the following pages:

1.1-1, 1.1-2, 1.1-4
2.1-4, 2.6-1, 2.6-2, 2.6-3, 2.6-4, 2.6-5, 2.8-3, 2.8-11, 2.8-12, 2.8-13, 2.8-15, 2.10-2, 2.10-3
3.1-1, 3.2-1, 3.2-2, 3.2-3, 3.2-6, 3.2-7, 3.2-9, 3.2-10, 3.3-1, 3.3-7, 3.3-8
added 3.3-9 and 3.3-10
4.1-1, 4.1-2, 4.1-3, 4.1-4, 4.2-1, 4.2-2, 4.2-4, 4.2-5, 4.2-6 through 4.2-8, 4.4-1, 4.5-1 through 4.5-4
4.6-1 through 4.6-8, 4.7-2 4.8-1, 4.9-1, 4.9-2, 4.10-1, 4.10-2, 4.11-1, 4.12-1, 4.12-2, 4.13-1; 4.13-2
4.14-1, 4.14-2, 4.17-2, 4.17-3, 4.18-1 4.19-1 through 4.19-8, 4.20-1, 4.20-2, 4.20-3, 4.20-4
deleted 4.20-5 and 4.20-6
4.21-1 through 4.21-3, 4.23-1 through 4.23-6, 4.24-1 through 4.24-6, 4.25-1 through 4.25-8
deleted 4.25-9 through 4.25-12
4.26-1, 4.26-3, 4.26-4, 4.27-1 through 4.27-8
deleted 4.27-9 through 4.27-12
4.29-1, 4.29-3 through 4.29-6, 4.30-1, 4.30-3 through 4.30-5, 4.31-1, 4.31-3, 4.31-4
4.32-1 through 4.32-3, 4.33-1, 4.33-2, 4.35-1, 4.35-2, 4.35-3, 4.35-10, 4.36-1, 4.36-2, 4.36-5, 4.36-6
added 4.37-1 and 4.37-2, 4.38-1 and 4.38-2, 4.39-1 through 4.39-10
5.2-3, 6.3-2 through 6.3-6, 7.3-2
8.1-1 through 8.1-12, 8.2-7, 8.2-8, 8.2-9, 8.2-16, 8.2-17, 8.2-42, 8.2-46, 8.2-48
A.2-9, A.3-3, A.4-1, C.1-1, C.1-2 and C.1-7.

The change page packet also includes the latest revision of the Pneumatic/Hyraulic Schematic, 7616069B.

Changes that are part of the most recent revision are indicated in the printed copy by a bar in the margin of the amended page.

This document applies to the latest software listed and higher versions. When a subsequent software version affects the information in this document, the changes will be included on minor revision change pages or summarized on a Notice of Information Update form and will be released by service memo.

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1.1 MANUAL DESCRIPTION

Scope

This manual provides the reference information and procedures needed for servicing and maintaining the BECKMAN COULTER™ A^{C}•T™ 5diff hematology analyzer (hereafter referred to as the A^{C}•T 5diff hematology analyzer or the instrument). It is available both online and in hard copy. The online manual is released on the Service Resource Kit CD-ROM, PN 6417471.

This manual is to be used in conjunction with the following customer documents and does not contain information and procedures already covered in these documents:

Document	Language	Part Number
Operator's Guide	English	4237615
	French	4237630
	Italian	4237631
	German	4237632
	Spanish	4237633
	Chinese	4237634
Host Transmission Specification	English	4277065

Notification of Updates

Any service memo that affects the information in this manual will include either minor revision change pages or a Notice of Information Update form for this manual. A Notice of Information Update form will summarize the changes and will list the specific headings, figures, and tables affected.

Intended Audience

To use this manual effectively, you need the following:

- An operator's knowledge of the A^{C}•T 5diff hematology analyzer
- A thorough understanding of -
  - Basic electronic and pneumatic principles and devices
  - Reagent systems
  - Quality control
  - Troubleshooting concepts
- The ability to -
  - Use basic mechanical tools and understand related terminology
  - Use a digital voltmeter (DVM)
  - Read pneumatic/hydraulic schematics and understand related terminology
  - Read electronic schematics and understand related terminology

Organization

The material in this manual is organized into eight chapters and two appendices. To make it easier to access the information:

- In the online manual, each page has a Contents button linked to a master table of contents and an Index button linked to an alphabetic index.
- In the printed manual, there is a master table of contents at the beginning of the manual, a chapter-specific table of contents at the beginning of each chapter, and an alphabetic index at the end of the manual.

The chapters / appendices contain:

Chapter 1, INTRODUCTION - A brief description of this manual and essential safety information.

Chapter 2, INSTRUMENT DESCRIPTION - An introduction to the A^{C}•T5 diff hematology analyzer and a description of how it functions.

Chapter 3, INSTALLATION PROCEDURES - Installation and verification procedures.

Chapter 4, SERVICE AND REPAIR PROCEDURES - The procedures for servicing/repairing the A^{C}•T 5diff hematology analyzer.

Chapter 5, MAINTENANCE PROCEDURES - The procedures for maintaining the A^{C}•T 5diff hematology analyzer.

Chapter 6, SCHEMATICS - The schematic diagrams and tubing lists.

Chapter 7, TROUBLESHOOTING - An error message table.

Chapter 8, PARTS LISTS - The master parts list followed by the illustrated parts list.

Appendix A, QUICK REFERENCE INFORMATION - Quick reference information: tolerances and limits; connectors, test points and jumpers for the circuit cards; the software menu trees; location diagrams and summarized functions for main analyzer components.

Appendix B, SOFTWARE INTERFACE - Tables of fatal and non-fatal error messages.

Appendix **C, FLAG SENSITIVITY AND THRESHOLDS** - An overview of the theory including default values; also includes the setup procedures.

ABBREVIATIONS - A list of abbreviations, acronyms, and reference designators used in this manual.

Numbering Format

Each chapter of this manual is further divided into topics that are numbered sequentially, beginning at one. The numbering format for the topic heading, which is called the primary heading, is chapter number, decimal point, topic number. For example, the primary heading number for the third topic covered in Chapter 2 is 2.3.

The page, figure, and table numbers are tied directly to the primary heading number. For example, Heading 2.3 begins on page 2.3-1, the first figure under Heading 2.3 is Figure 2.3-1 and the first table under Heading 2.3 is Table 2.3-1.

Note: Primary headings always begin at the top of a right-hand page.

Special Headings

Throughout this manual, WARNING, CAUTION, IMPORTANT, ATTENTION, and Note headings are used to indicate potentially hazardous situations and important or helpful information.

WARNING

A WARNING indicates a situation or procedure that, if ignored, can cause serious personal injury. The word WARNING is in bold-faced text in the printed manual and is red in the online manual.

CAUTION

A CAUTION indicates a situation or procedure that, if ignored, can cause damage to the instrument.The word CAUTION is in bold-faced text in the printed manual and is red in the online manual.

IMPORTANT

An IMPORTANT indicates a situation or procedure that, if ignored, can result in erroneous test results.The word IMPORTANT is in bold-faced text in the printed manual and is red in the online manual.

ATTENTION

An ATTENTION contains information that is critical for the successful completion of a procedure and/or operation of the instrument.The word ATTENTION is in bold-faced text in the printed manual and is red in the online manual.

Note

A Note contains information that is important to remember or helpful in performing a procedure.

Conventions

This manual uses the following conventions.

- Instrument or analyzer refers to the A^{C}•T 5diff hematology analyzer.
- Main card refers to the motherboard in the instrument.
- Main Menu refers to the initial menu displayed on the instrument after Startup.
- Each menu option consists of an item number followed by bold, uppercase text. For example, **3. REAGENTS** is the third option on the Main Menu.

  Note: Both the menu item number and text are displayed on the LCD screen. The item number next to the menu item indicates the numeric pushbutton on the front of the analyzer that can be pressed to select the menu option.
- Keys on the analyzer keypad are in bold, uppercase letters. For example, press **ENTER** indicates the operator should press the **ENTER** pushbutton on the instrument keypad.

- To select a menu item,
    - Use the arrow keys to highlight the desired menu item then press the **ENTER** pushbutton on the front of the analyzer to select the highlighted option.

      or

    - Simply press the numeric pushbutton (on the front of the analyzer) that correlates with the desired option. This is the faster way to select a menu item.

  For example, to select the **3. REAGENTS** menu item from the Main Menu, you may:
    - Use the down arrow to highlight the **3. REAGENTS** option and then press the **ENTER** pushbutton on the front of the analyzer.

      or

    - Press the pushbutton labeled **3** on the front of the analyzer.
- Select menu item ▸▸ sub-menu item indicates the software options you have to select, as well as the order in which you should select them. For example, to prime the diluent reagent:

  From the Main Menu, select **3. REAGENTS ▸▸ 3. PRIME ▸▸ 1. DILUENT**.
- Italics us used to indicate screen messages. For example:

  The message *CYCLE IN PROGRESS. PLEASE WAIT* . . . appears on the screen.
- A^{C}•T 5diff Rinse reagent is sometimes referred to as Rinse.
- A^{C}•T 5diff Fix reagent is sometimes referred to as Fix.
- A^{C}•T 5diff Hgb Lyse reagent is sometimes referred to as Hgb Lyse.
- A^{C}•T 5diff WBC Lyse reagent is sometimes referred to as WBC Lyse.
- A^{C}•T 5diff Diluent reagent is sometimes referred to as Diluent or diluent.
- In the electronic version of the manual:
    - Links to additional information are in blue and are underlined. To access the linked information, select the blue underlined text.
    - The material is divided into many small sections (electronic files) to enhance the loading and accessibility features.
    - Every primary heading is a separate file and whenever possible the amount of material contained within one primary heading is limited to four to ten pages.
    - If a primary heading must be large, such as an illustrated parts list (IPL), invisible breaks are added to the electronic file to further divide it.

      Note: Unless you are scrolling, these divisions are invisible. If you choose to scroll through the IPL, you will encounter stop points. When you scroll to the end of a section and encounter a stop point, use the navigation bar to access the next section.
    - To move from one section (electronic file) to the next in the HTML version of the manual, use the right and left arrows on the navigation bars displayed at the top and bottom of each section.

Graphics

All graphics, including screens and printouts, are for illustration purposes only and must not be used for any other purpose.

1.2 SAFETY PRECAUTIONS

Electronic

WARNING Risk of personal injury. Contacting exposed electronic components while the instrument is attached to power can cause personal injury from electric shock. Power down completely before removing covers to access electronic components.

WARNING Risk of personal injury or damage to electronic components. While performing maintenance or service on the instrument, rings and other metal jewelry can become caught in the instrument. To avoid personal injury or damage to the instrument, remove rings and other metal jewelry before performing maintenance or service on the electronic components of the instrument.

CAUTION Risk of damage to electronic components. If the power is ON while removing or replacing printed circuit cards and components, the instrument could be damaged. To prevent damage to electronic components, always be sure power is OFF before removing or replacing printed circuit cards and components.

CAUTION Risk of damage to electronic components. Electrostatic discharge (ESD) can damage add-in circuit cards and other electronic components. If there is a possibility of ESD damage with a procedure, then perform that procedure at an ESD workstation, or wear an antistatic wrist strap attached to a metal part of the chassis connected to an earth ground.

Biological

WARNING Risk of personal injury or contamination. If you do not properly shield yourself while servicing the instrument with the doors open, you may become injured or contaminated. To prevent possible injury or biological contamination, you must wear appropriate safety glasses, a lab coat, and gloves when servicing the instrument with the doors open.

Use care when working with pathogenic materials. Means must be available to decontaminate the instrument, provide ventilation, and to dispose of waste liquid. Refer to the following publications for further guidance on decontamination:

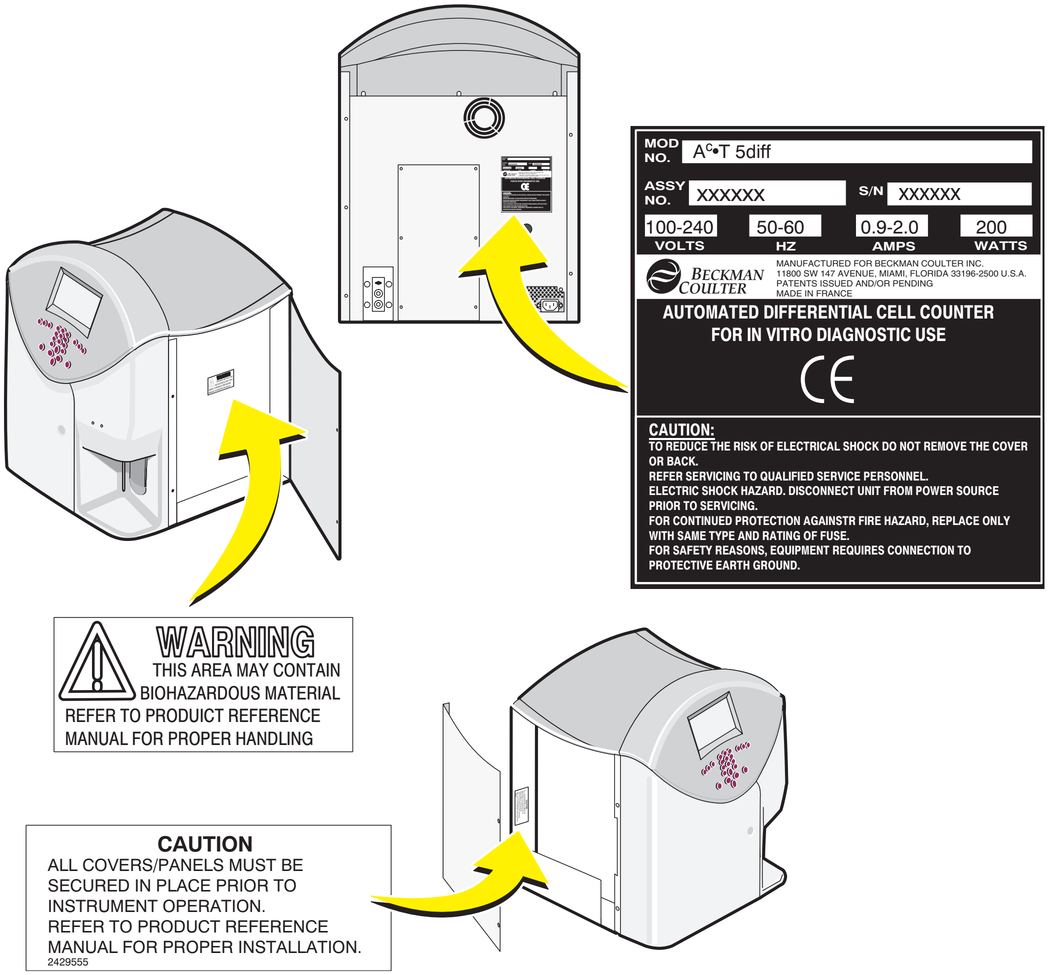
- Biohazards Safety Guide, 1974, National Institute of Health.
- Classifications of Etiological Agents on the Basis of Hazards, 3d ed., June 1974, Center for Disease Control, U.S. Public Health Service.

Troubleshooting

Bring the following Warning to the customer's attention before advising that customer to perform any service, maintenance or troubleshooting procedures on the A^{C}•T 5diff hematology analyzer. Also, make sure customers are aware of the Warning and information labels shown in Figure 1.2-1.

WARNING Risk of personal injury or contamination. If you do not properly shield yourself while performing service, maintenance, and troubleshooting procedures, residual fluids in the instrument could injure or contaminate you. Beckman Coulter recommends that you wear barrier protection, such as appropriate safety glasses, a lab coat, and gloves throughout the performance of service, maintenance, and troubleshooting procedures to avoid contact with cleaners and residual fluids in the instrument.

Figure 1.2-1 Warning and Information Label



MOD NO. A^{c}•T 5diff

ASSY NO. XXXXXX S/N XXXXXX

100-240	50-60	0.9-2.0	200
VOLTS	HZ	AMPS	WATTS

BECKMAN COULTER
MANUFACTURED FOR BECKMAN COULTER INC.
11800 SW 147 AVENUE, MIAMI, FLORIDA 33196-2500 U.S.A.
PATENTS ISSUED AND/OR PENDING
MADE IN FRANCE

AUTOMATED DIFFERENTIAL CELL COUNTER
FOR IN VITRO DIAGNOSTIC USE
CE

CAUTION:
TO REDUCE THE RISK OF ELECTRICAL SHOCK DO NOT REMOVE THE COVER OR BACK.
REFER SERVICING TO QUALIFIED SERVICE PERSONNEL.
ELECTRIC SHOCK HAZARD. DISCONNECT UNIT FROM POWER SOURCE PRIOR TO SERVICING.
FOR CONTINUED PROTECTION AGAINSTR FIRE HAZARD, REPLACE ONLY WITH SAME TYPE AND RATING OF FUSE.
FOR SAFETY REASONS, EQUIPMENT REQUIRES CONNECTION TO PROTECTIVE EARTH GROUND.

WARNING
THIS AREA MAY CONTAIN
BIOHAZARDOUS MATERIAL
REFER TO PRODUICT REFERENCE
MANUAL FOR PROPER HANDLING

CAUTION
ALL COVERS/PANELS MUST BE
SECURED IN PLACE PRIOR TO
INSTRUMENT OPERATION.
REFER TO PRODUCT REFERENCE
MANUAL FOR PROPER INSTALLATION.
2429555

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2.1 INTRODUCTION TO THE A^{C}•T 5diff HEMATOLOGY ANALYZER

Purpose

The purpose of the A^{C}•T 5diff hematology analyzer is to identify normal patient results with all normal system-generated parameters and to flag or identify patient results that require additional studies.

Function

The A^{C}•T 5diff analyzer is a quantitative, fully automated (microprocessor controlled) hematology analyzer and leukocyte differential counter **For In Vitro Diagnostic Use** in clinical laboratories. The A^{C}•T 5diff hematology analyzer reports a complete blood count (CBC) and white blood cell differential (DIFF) on open-vial, whole-blood specimens.

The CBC consists of white blood cell count (WBC), red blood cell count (RBC), hemoglobin (Hgb), hematocrit (Hct), mean cell volume (MCV), mean cell hemoglobin (MCH), mean cell hemoglobin concentration (MCHC), red cell distribution width (RDW), platelet count (Plt), and mean platelet volume (MPV).

The DIFF (a 5-part leukocyte differential) consists of the percentage (%) and absolute number (#) of the following WBC populations: neutrophils (NE% and NE#), lymphocytes (LY% and LY#), monocytes (MO% and MO#), eosinophils (EO% and EO#), and basophils (BA% and BA#).

Six parameters are qualitative and are **For Research Use Only. Not For In Vitro Diagnostic Procedures**. These parameters include the plateletcrit (Pct), platelet distribution width (PDW), percentage and absolute number of immature cells (IMM% and IMM#), and percentage and absolute number of atypical lymphocytes (ATL% and ATL#).

Description

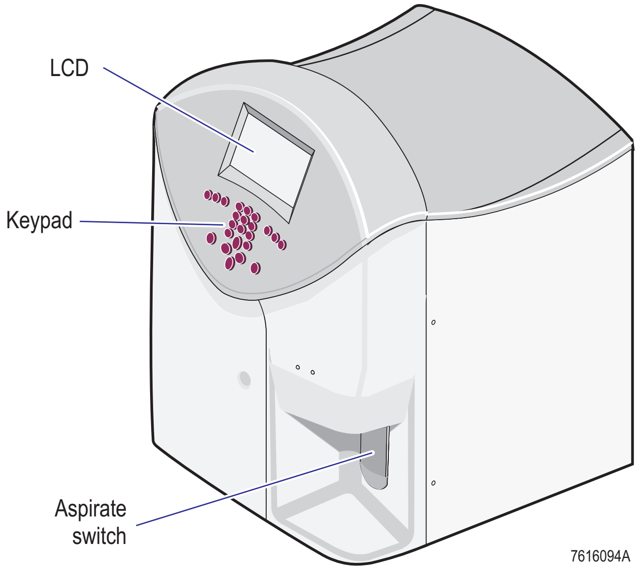
Components

The A^{C}•T 5diff hematology analyzer is contained in one unit, with additional space needed only for the external printer, the diluent reagent container, and a waste container (if used).

Interaction with the A^{C}•T 5diff Hematology Analyzer

The A^{C}•T 5diff analyzer uses an Open-Vial mode of operation. Pressing the aspirate switch (Figure 2.1-1) initiates a cycle. When the sample probe is submerged in a whole-blood specimen and the aspirate switch is pressed, sample is pulled from the specimen tube into the sample probe. As the cycle continues, the instrument then dilutes and analyzes this sample. When the analysis is complete, results appear on a LCD (Figure 2.1-1) and are available to the printer.

Figure 2.1-1 User Interfaces on the A^{C}•T 5diff Hematology Analyzer



You also interact with the instrument through the use of a menu system displayed on a 128 by 240 pixels LCD and a control panel keypad with buttons that are used to setup and operate the instrument (Figure 2.1-1).

Since most input/output functions of the operating system software are controlled by the user, the pushbutton keypad and LCD screen are particularly important because they provide the physical user interface with the software.

See Heading 2.10, SOFTWARE STRUCTURE for more specific information as well as a graphic representation of the available menus and menu items (or options).

Modes of Operation

The A^{C}•T 5diff hematology analyzer has two operating modes: CBC and CBC/DIFF.

CBC Mode

Twelve parameters are generated in the CBC mode of operation - 10 parameters **For In Vitro Diagnostic Use** and two qualitative parameters that are **For Research Use Only. Not For In Vitro Diagnostic Procedures**:

Parameters (For In Vitro Diagnostic Use)	Parameters (For Research Use Only)
WBC	Pct
RBC	PDW
Hgb	
Hct	
MCV	
MCH	
MCHC	
RDW	
Plt	
MPV	

CBC/DIFF Mode

26 parameters are generated in the CBC/DIFF mode of operation - 20 parameters **For In Vitro Diagnostic Use** and six qualitative parameters that are **For Research Use Only. Not For In Vitro Diagnostic Procedures**:

Parameters (For In Vitro Diagnostic Use)	Parameters (For Research Use Only)
WBC	Pct
RBC	PDW
Hgb	IMM% and IMM#
Hct	ATL% and ATL#
MCV	
MCH	
MCHC	
RDW	
Plt	
MPV	
NE% and NE#	
LY% and LY#	
MO% and MO#	
EO% and EO#	
BA% and BA#	

Reagent Consumption

Table 2.1-1 shows the instrument reagent consumption by cycle.

Table 2.1-1 A^{C}•T 5diff Hematology Analyzer Reagent Consumption, Software Version 1.03

Cycle	**A^{C}•T 5diff reagents with usage per cycle**					**Approximate Duration**
	Diluent	**WBC Lyse**	**Rinse**	**Fix**	**Hgb Lyse**	
CBC	20.5 mL	2.1 mL	0.9 mL	Not used	0.4 mL	1 minute
CBC/DIFF	25.6 mL	2.1 mL	0.9 mL	1.0 mL	0.4 mL	1 minute
Startup†	62.0 mL	2.1 mL	3.7 mL	1.0 mL	1.4 mL	3 minutes 40 seconds
Shutdown	25.5 mL	Not used	14.0 mL	Not used	1.0 mL	2 minutes 45 seconds
Prime diluent	35.5 mL	Not used	Not used	Not used	Not used	2 minutes 30 seconds
Prime rinse	Not used	Not used	25.8 mL	Not used	Not used	1 minute 20 seconds
Prime fix	Not used	Not used	Not used	25.8 mL	Not used	1 minute 30 seconds
Prime WBC Lyse	Not used	25.8 mL	Not used	Not used	Not used	1 minute 20 seconds
Prime Hgb Lyse	2.5 mL	Not used	Not used	Not used	4.2 mL	1 minute
Prime All Reagents	23.7 mL	16.0 mL	16.0 mL	16.0 mL	4.2 mL	3 minutes 20 seconds
Extended Cleaning	12.5 mL	Not used	6.0 mL	Not used	Not used	1 minute 35 seconds
System Reset Cycle	24.0 mL	Not used	1.4 mL	Not used	1.0 mL	1 minute 25 seconds

† *For one background count only. The maximum is three.*

2.2 OPERATION PRINCIPLES

Overview

The A^{C}•T 5diff analyzer is a fully automated hematology analyzer providing a complete WBC five-part differential, which is determined simultaneously by the A^{C}V Technology (Absorbance Cytochemistry and Volume Technology) and the white blood cell/basophil (WBC/BASO) methodologies.

The A^{C}V Technology uses absorbance, cytochemistry, and focused flow impedance. The WBC/BASO methodology uses differential lysis, impedance technology, and differential thresholds. See Table 2.2-1.

Table 2.2-1 A^{C}•T 5diff Analyzer Measurement Technologies

Fluid Dynamics	Technology	Measurements	Output
Dual Focused Flow	A^{C}V Technology	Light absorbance of cytochemically-stained cells	Lymphocytes, monocytes, neutrophils, eosinophils, immature cells, and atypical lymphocytes
Volume aperture	Differential lysis using the Coulter Principle	Volume and count	WBC count, basophil percentage, and basophil count
Volume aperture	Coulter Principle	Volume and count	RBC count, platelet count, and hematocrit

Measurement Principles

Coulter Principle

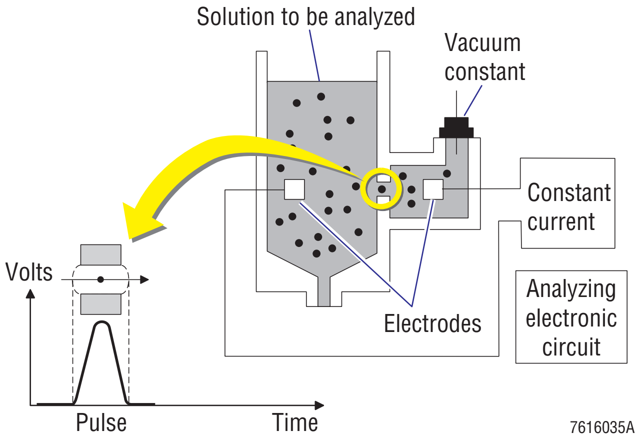
In the A^{C}•T 5diff analyzer, the Coulter Principle is used to analyze the final red blood cell and platelet (RBC/Plt) dilution and the WBC/BASO dilution. This electronic method of counting and sizing particles is based on the fact that cells, which are poor conductors of electricity, will interrupt a current flow. The impedance variation generated by the passage of nonconductive cells through a small, calibrated aperture is used to determine the count (number of particles) and size (volume) of the particles passing through the aperture within a given time period.

Aperture Sensor System

The RBC/Plt aperture sensor system determines the cell count and size of red blood cells and platelets. The WBC/BASO aperture sensor system determines the cell count and size of white blood cells. Additionally, the differentiation between basophils and other white blood cells is related to the A^{C}•T 5diff WBC Lyse-specific lytic action on the white blood cells in the WBC/BASO bath.

To sense particles using the Coulter Principle (Figure 2.2-1), a current flow is established so changes in that flow can be monitored. In this sensing system, an electrode is placed on each side of the aperture (Figure 2.2-1). The most visible electrode is referred to as the counting head. These electrodes are the conductive metallic housings attached to the front of the RBC and WBC/BASO baths. The second electrode, referred to as the bath electrode, is not as conspicuous. This electrode is located inside the bath. The aperture is located between the counting head and the bath electrode.

Figure 2.2-1 Coulter Principle



When the count circuit is activated and an electronically conductive reagent is in the RBC or WBC/BASO bath, an electric current continuously passes through the aperture. Current moving between the two electrodes establishes the electronic flow through the aperture.

Once a sample is aspirated, an aliquot of that aspirated sample is diluted with reagent (an electrolyte) and is delivered to the RBC or WBC/BASO bath using tangential flow, which ensures proper mixing of the dilution. When the cells suspended in the conductive reagent are pulled through a calibrated aperture, the electrical resistance between the two electrodes increases proportionately with the cell volume (Figure 2.2-1).

The resistance creates a pulse that is sensed and counted as a particle by the instrument. The amount of resistance (amplitude of each pulse) is directly related to the size of the particle that produced it.

The generated pulses have a very low voltage, which the amplification circuit increases so that the electronic system can better analyze the pulses and eliminate the background noise.

Applying the Coulter Principle

The A^{C}•T 5diff analyzer makes several dilutions of an aspirated whole-blood sample. The RBC/Plt dilution begins in the DIL1/HGB (first dilution/hemoglobin) bath but is actually analyzed in the RBC bath. The final dilution in the RBC bath is used to determine the cell count and size of red blood cells and platelets.

The WBC/BASO aperture sensor system is directly responsible for determining the cell count and size of white blood cells. The differentiation between basophils and other white blood cells is also related to the A^{C}•T 5diff WBC Lyse-specific lytic action on these white blood cells.

Thresholds, which are electronically set size limits, exclude unwanted particles, such as debris, from the analysis. Particles above the threshold are analyzed, and particles below the threshold are excluded.

A^{C}V Technology

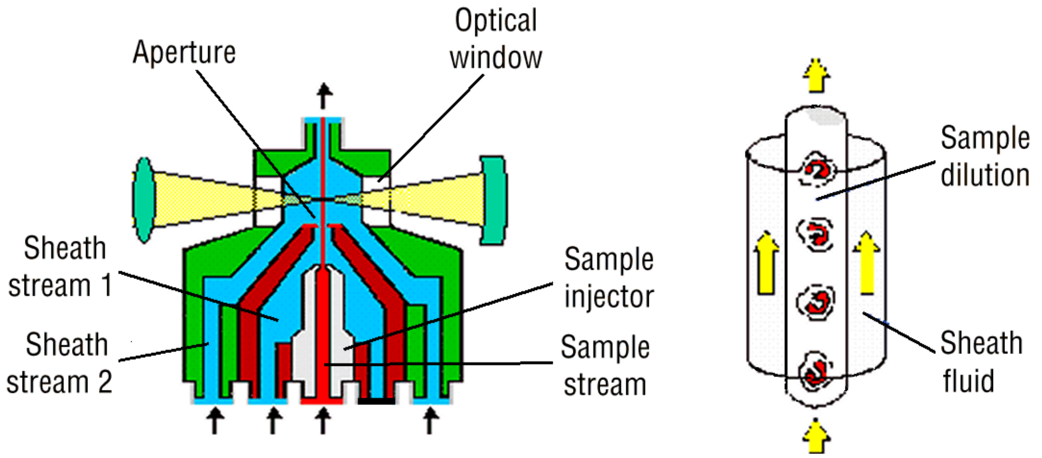
In the DIFF (differential) bath, 25 µL of whole blood is mixed with 1,000 µL of A^{C}•T 5diff Fix reagent for 12 seconds, then stabilized with 1,000 µL of A^{C}•T 5diff Diluent for an additional three seconds. This reaction lyses the red blood cells, preserves the leukocytes at their original size, and differentially stains the lymphocytes, monocytes, neutrophils, and eosinophils, with eosinophils staining most intensely. The instrument maintains the reagents and reaction at a regulated temperature of 35°C (95°F).

Lymphocytes, monocytes, neutrophils, and eosinophils each have a unique nuclear and morphology structure and staining intensity; therefore, each cell type absorbs light differently. Each stained cell is individually focused by the Dual Focused Flow (DFF) system and transported through the flow cell using sample pressure and diluent sheath flow.

Dual Focused Flow (DFF)

DFF fluid dynamics uses a hydrodynamic focusing process to focus individual cells or particles in a stream of diluent (Figure 2.2-2). The focused sample stream of the A^{C}•T 5diff analyzer is about 40 µm in diameter.

Figure 2.2-2 Dual Focused Flow Process



DFF uses sheath fluid to surround and force cells suspended in diluent to pass one at a time through the center of the flow cell. The first sheath flow focuses the sample through the impedance aperture. The second sheath flow maintains the focused flow of cells as they exit the aperture into the optical flow cell. Hydrodynamic focusing in the flow cell enables accurate and rapid cell-by-cell measurements on a large number of individual cells.

Flow Cell

Sequential analyses for cell volume (impedance) and light absorbance are performed in the flow cell. A total of 72 µL of sample is injected through the flow cell for 15 seconds. The flow cell incorporates a 60 µm aperture for cellular volume analysis and about a 40 µm measurement area for light absorbance.

Focused Flow Impedance

Focused flow impedance technology measures the electrical resistance of a cell as it passes through the aperture in the flow cell. The change in resistance is directly proportional to the volume of the cell.

Absorbance Cytochemistry

As a cell passes through the optical portion of the flow cell, light is scattered in all directions. A sensor detects only forward scattered light. The optical measurement is derived as a function of the amount of light lost due to diffraction and absorbance, as compared to full transmission when no cell is present.

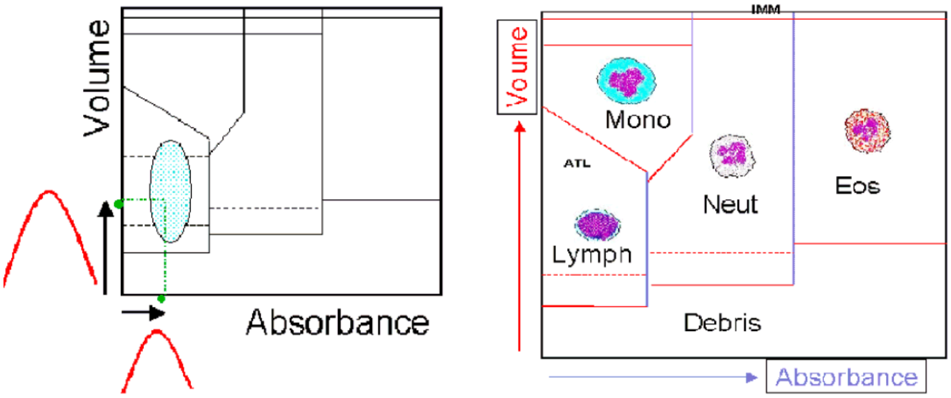
The collected signals are converted into voltage pulses and are processed. The magnitude of the voltage pulses are proportional to the physical and chemical characteristics of the cells being analyzed. Light absorbance is related to cellular contents (granularity, nuclear content, and so forth) after cytochemical staining. These measurements provide the information for lymphocytes, monocytes, neutrophils, and eosinophils, and their precursors.

Signal Processing

The signals from the flow cell aperture and from the optical measurement are correlated by a window of time. The optical pulse must be detected within 100 to 300 microseconds of the impedance pulse; otherwise, the signal is rejected.

The output signals from the focused flow impedance and the light absorbance measurements are combined to define the WBC differential population clusters. See Figure 2.2-3.

Figure 2.2-3 Signal Processing



Thresholds

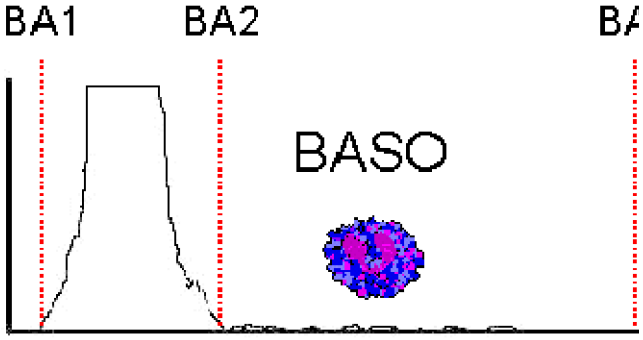
Most of the population partition thresholds are fixed and give the limits of the morphological normality of leukocytes. Changes in the morphology of a population are expressed on the DiffPlot by a shifting of the corresponding population. Volume and absorbance thresholds are used to detect shifting populations.

WBC/BASO Methodology

In the WBC/BASO bath, 10 µL of whole blood is mixed with 2,000 µL of A^C•T 5diff WBC Lyse reagent. This reaction lyses the red blood cells and specifically differentiates between basophils and other leukocytes by volume. The instrument maintains the reagents and reaction at a regulated temperature of 35°C (95°F).

Using a constant vacuum, the instrument then pulls the sample through an 80 µm aperture. As each cell passes through the aperture, a pulse is generated proportional to the cellular volume. The total leukocyte count and basophil percentage are determined by specific thresholds on the WBC/BASO histogram (Figure 2.2-4).

Figure 2.2-4 Basophil Thresholds



Sample Analysis Overview

Aspiration

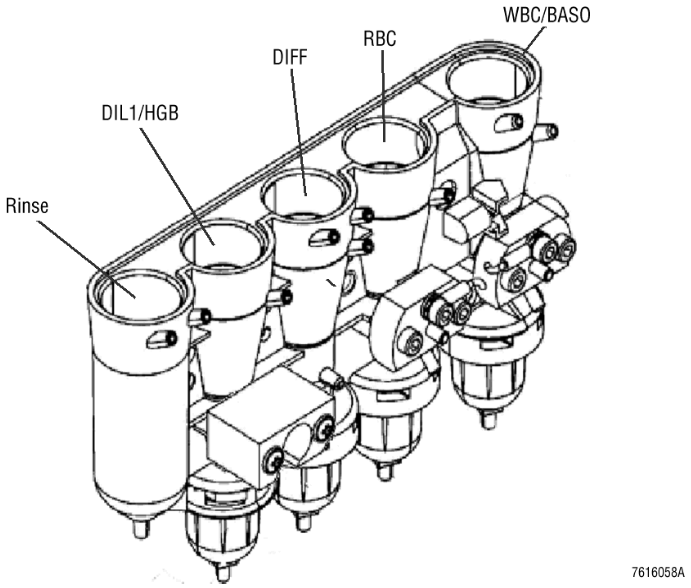
When the sample probe is immersed in a whole-blood specimen and the aspirate switch is pressed, sample is pulled from the tube into the sample probe. Depending on the selected mode of operation, the A^C•T 5diff analyzer aspirates either 30 µL (CBC mode) or 53 µL (CBC/DIFF mode) of sample.

The volume of sample aspirated into the sample probe is sufficient to make all the dilutions needed to develop parameter results in the selected mode of operation.

Dilution

Using the Sequential Dilution System (SDS) technique, the aspirated sample is partitioned as it is distributed to make a series of dilutions in a series of baths (Figure 2.2-5).

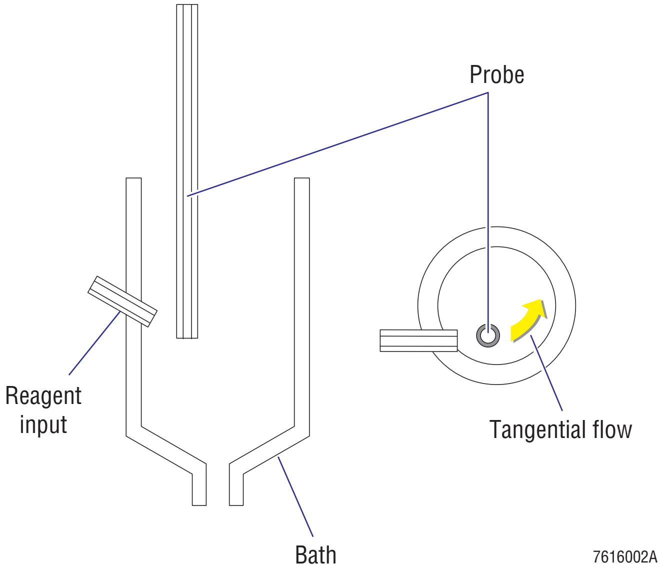
Figure 2.2-5 Bath Assembly


WBC/BASO
RBC
DIFF
DIL1/HGB
Rinse
7616058A

Delivery

In the CBC and the CBC/DIFF modes, each aliquotted sample is delivered to its appropriate bath using a tangential flow (Figure 2.2-6) of reagent, which mixes the diluted sample and minimizes viscosity problems.

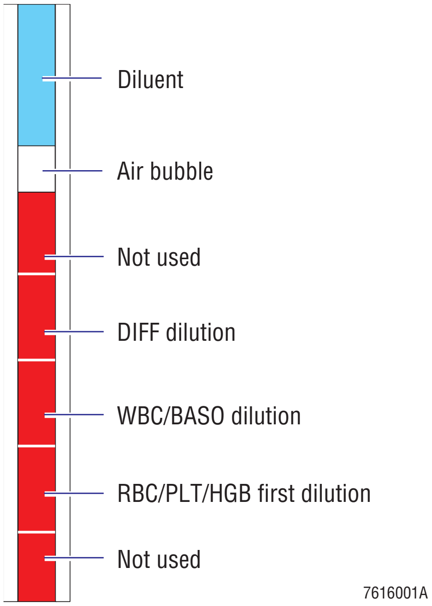
Figure 2.2-6 Sample Delivery Using Tangential Flow


Probe
Reagent
input
Tangential flow
Bath
7616002A

Sample Partitioning

Figure 2.2-7 shows the sample partitioning that occurs in the CBC/DIFF mode. Notice there are three aliquots of the aspirated whole-blood sample that will be used to make dilutions.

Figure 2.2-7 CBC/DIFF Mode - Sample Partitions inside the Probe



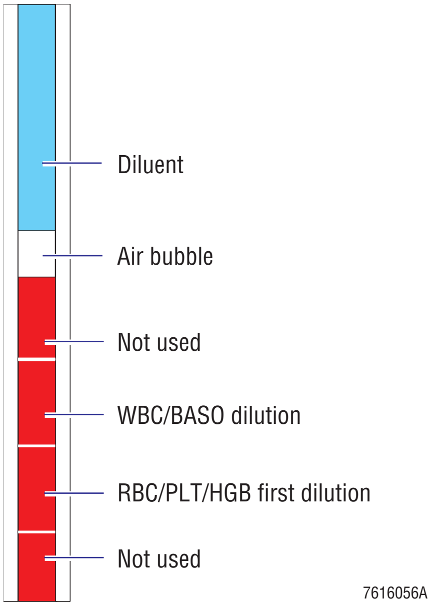
CBC/DIFF Mode

After aspiration in the CBC/DIFF mode, aliquots of the whole-blood sample are distributed to the various baths as follows (Figure 2.2-5):

- The 3 µL sample aliquot at the tip of the probe is discarded into the rinse chamber as the exterior of the sample probe is rinsed, ensuring sample integrity.
- 10 µL of sample is delivered to the DIL1/HGB bath for use in preparing the primary RBC/Plt dilution and for measuring the Hgb value.
- 10 µL of sample is delivered to the WBC/BASO bath for the WBC/BASO count.
- 25 µL of sample is delivered to the DIFF bath for development of the DiffPlot.
- 5 µL of remaining sample is discarded into the rinse chamber.

Figure 2.2-8 shows the sample partitioning that occurs in the CBC mode. Notice there are only two aliquots of the aspirated whole-blood sample that will be used to make dilutions in this mode of operation. (The DIFF aliquot is not needed in the CBC mode.)

Figure 2.2-8 CBC Mode - Sample Partitions inside the Probe



CBC Mode

After aspiration in the CBC mode, aliquots of the whole-blood sample are distributed to the various baths as follows (Figure 2.2-5):

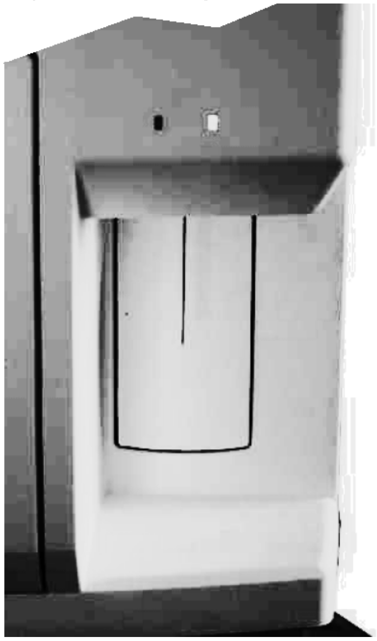
- The 3 µL sample aliquot at the tip of the probe is discarded into the rinse chamber as the exterior of the sample probe is rinsed, ensuring sample integrity.
- 10 µL of sample is delivered to the DIL1/HGB bath for use in preparing the primary RBC/Plt dilution and for measuring the Hgb value.
- 10 µL of sample is delivered to the WBC/BASO bath for the WBC/BASO count.
- 7 µL of remaining sample is discarded into the rinse chamber.

2.3 CYCLE DESCRIPTION

This cycle description focuses on the sequence of the sample probe movement among the baths. It also focuses on the volume of sample and reagents being delivered to make the dilutions needed for sample analysis.

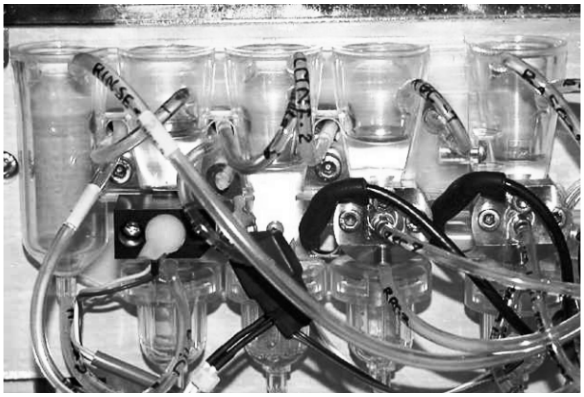
Cycle Start Conditions

Figure 2.3-1 Sample Probe and LED at Start of a Cycle



- The sample probe is in its home position.
- The green LED is glowing indicating the instrument is ready.

Figure 2.3-2 Baths Assembly at Start of a Cycle



- All the baths (except the rinse chamber) are filled with clean diluent.

Sample Flow

- To initiate a cycle, submerge the sample probe in a well-mixed whole-blood specimen and press the aspirate switch to start the cycle.
- All the baths drain.
- A sample of the whole-blood specimen is aspirated.
    - 53 µL in the CBC/DIFF mode.
    - 30 µL in the CBC mode.
- The horizontal traverse assembly positions the sample probe over the rinse chamber.
- 3 µL sample aliquot at the tip of the sample probe is discarded into the rinse chamber as the exterior of the sample probe is rinsed. Discarding this aliquot helps ensure sample integrity.

Figure 2.3-3 Rinsing Probe Exterior After Aspiration

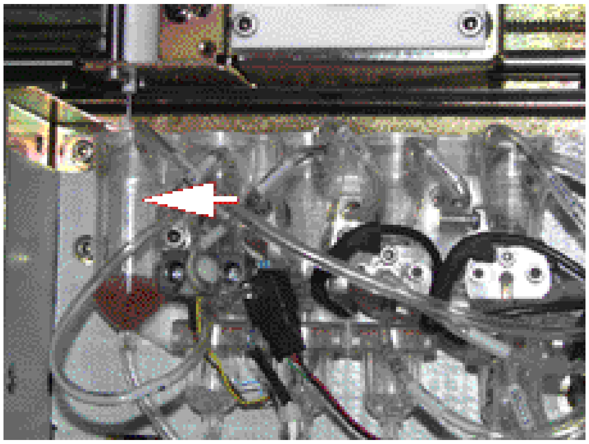
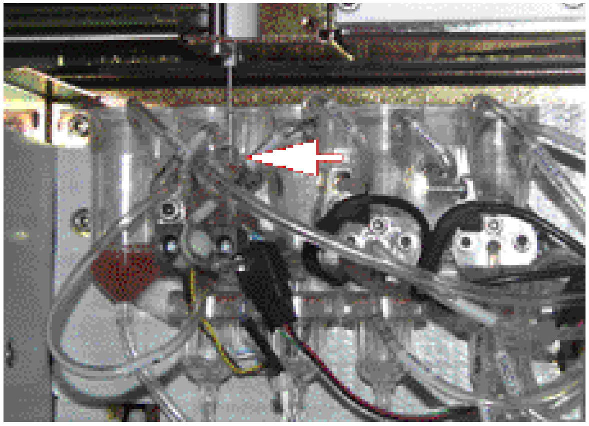
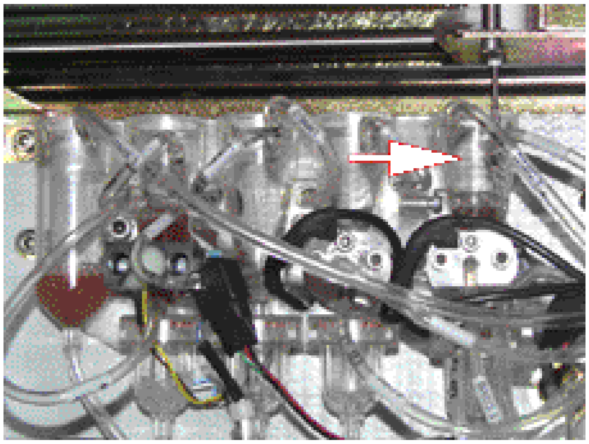


Figure 2.3-4 Making the RBC/PLT First Dilution



- The horizontal traverse assembly positions the sample probe over the DIL1/HGB (first dilution/Hgb) bath.
- The vertical traverse assembly moves the probe downward into the bath. The probe tip is positioned to produce a tangential flow when the sample and diluent are simultaneously dispensed into the bath. For a more detailed description of tangential flow, see Delivery under Heading 2.2, OPERATION PRINCIPLES.
- 10 µL of the whole-blood partitioned for making the first dilution is delivered to the DIL1/HGB bath using a tangential flow of 1.7 mL of diluent.
- The tangential flow of reagent mixes the sample and the diluent. Mixing bubbles enter the bath to make a uniform suspension of cells. This 1:170 dilution is commonly referred to as the first dilution.

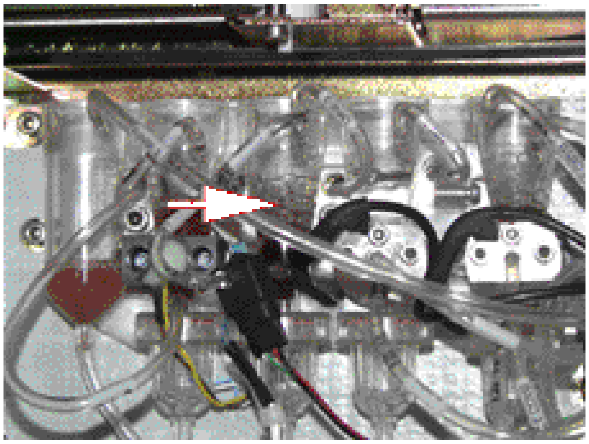
Figure 2.3-5 Making the WBC/BASO Dilution



- The horizontal traverse assembly positions the sample probe over the WBC/BASO bath
- The vertical traverse moves the probe downward into the bath. The tip of the probe is positioned so that a tangential flow occurs as the 10 µL of the whole-blood sample and 2.0 mL of WBC Lyse are simultaneously dispensed into the bath.
- The tangential flow of reagent mixes the sample and reagent. Mixing bubbles enter the bath to make a uniform suspension of cells. The WBC Lyse destroys the red blood cells and the specific lytic action on the white blood cells differentiates the basophils from other WBCs.

WBC/BASO Bath Dilution	
Whole-blood volume	10 µL
Volume of AC•T 5diff WBC Lyse reagent	2000 µL
Dilution ratio	1:200

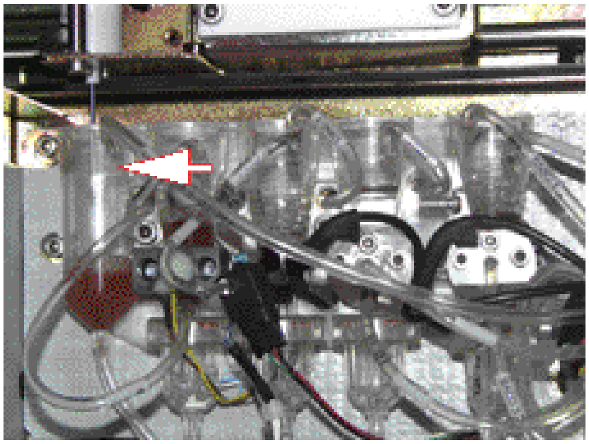
Figure 2.3-6 Making the DIFF Bath Dilution



- The horizontal traverse assembly moves the sample probe over the DIFF bath.
- The vertical traverse assembly moves the probe downward into the bath.
- The tip of the probe is positioned so that a tangential flow occurs as 25 µL of the whole-blood sample and 1.0 mL of Fix reagent are simultaneously dispensed into the bath.
- The tangential flow of reagent mixes the sample and the Fix reagent. Mixing bubbles enter the bath to make a uniform suspension of cells. The Fix reagent lyses the red blood cells, stabilizes the WBCs in their native form, and differentially stains the lymphocytes, monocytes, neutrophils, and eosinophils, with the eosinophils staining most intensely.
- After 12 seconds of incubation, the staining process inside the DIFF bath is completed by adding another 1.0 mL of diluent which stops the cytochemical reaction.

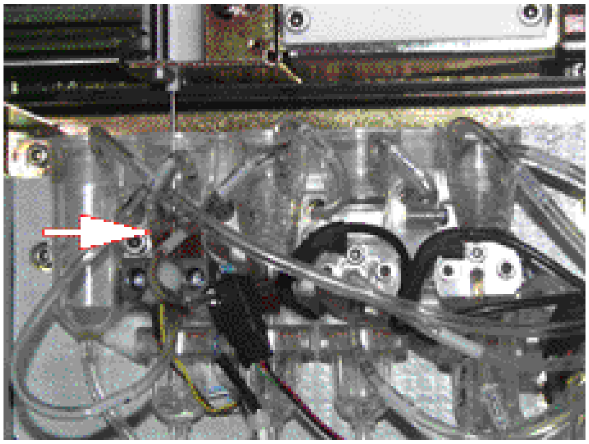
DIFF Bath Dilution	
Whole-blood volume	25 µL
Volume of AC•T 5diff Fix reagent	1000 µL
Volume of AC•T 5diff Diluent	1000 µL
Final dilution ratio	1:80

Figure 2.3-7 Double Rinse of the Sample Probe



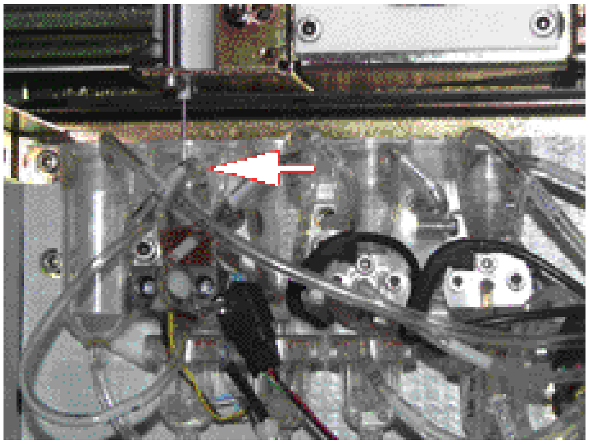
- The horizontal traverse assembly moves the sample probe over the rinse chamber.
- A double rinsing (interior and exterior) of the probe removes residual whole-blood sample from inside the probe.
    - In the CBC/DIFF mode, 5 µL is discarded in the rinse chamber.
    - In the CBC mode, 7 µL is discarded in the rinse chamber.

Figure 2.3-8 Aspirating from the First Dilution



- The horizontal traverse assembly moves the sample probe over the DIL1/HGB bath.
- The vertical traverse assembly moves the probe downward into the bath.
- 42.5 µL of the 1:170 first dilution is aspirated into the sample probe.

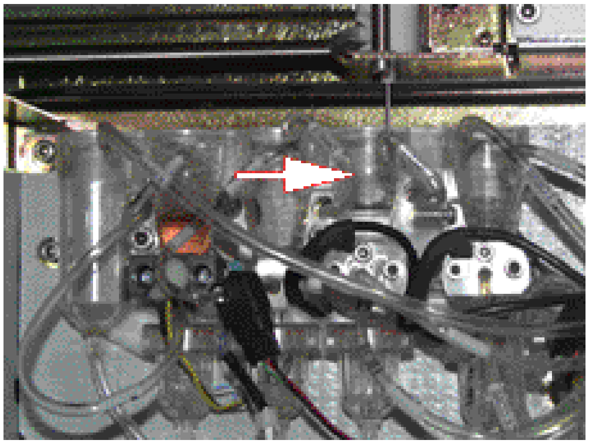
Figure 2.3-9 Rinsing the Outside of the Probe



- While still inside the DIL1/HGB bath, the exterior of the sample probe is rinsed with 0.4 mL of diluent.
- The vertical traverse assembly moves the probe up out of the bath.
- 0.4 mL of Hgb Lyse is added to the bath. The Hgb Lyse reagent rapidly destroys the red blood cells and converts a substantial proportion of the hemoglobin to a stable pigment so a hemoglobin value can be determined.
- Mixing bubbles enter the bath to ensure a uniform dilution.

DIL1/HGB Bath Dilution	
First dilution	1:170
Volume of first dilution removed	42.5 µL
Volume of AC•T 5diff Hgb Lyse reagent	400 µL
Volume of AC•T 5diff Diluent reagent	400 µL
Final dilution ratio	1:250

Figure 2.3-10 Making the RBC/Plt Dilution



- The horizontal traverse assembly moves the sample probe over the RBC bath.
- The vertical traverse assembly moves the probe downward into the bath.
- The tip of the probe is positioned so that a tangential flow occurs as the 42.5 µL of 1:170 dilution obtained from the first dilution in the DIL1/HGB bath and 2.0 mL of diluent are simultaneously dispensed into the bath
- An additional 0.5 mL of diluent is dispensed through the probe at the end of the second dilution.

RBC Bath Dilution	
Volume 1:170 dilution from DIL1/HGB bath	42.5 µL
Volume of AC•T 5diff Diluent reagent	2500 µL
Final dilution ratio	1:10,000

2.4 SAMPLE ANALYSIS

RBC and Platelet Analysis

The RBC/Plt dilution analyzes red blood cells and platelets. This dilution is prepared in two stages – the primary (first) dilution and the secondary (last) dilution.

The primary dilution is made in the DIL1/HGB bath, and the secondary dilution is made in the RBC bath (Figure 2.4-1).

Figure 2.4-1 Bath Assembly

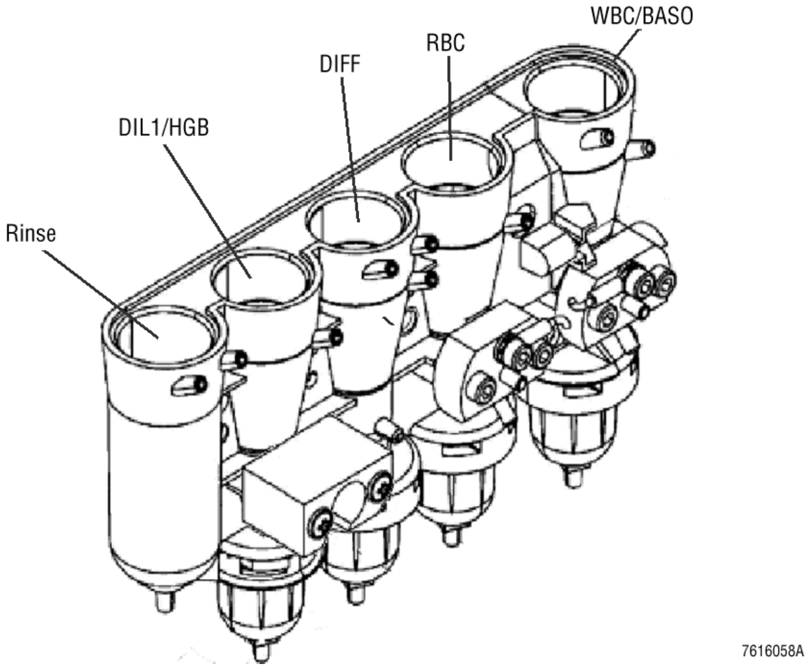


Table 2.4-1 summarizes the technical characteristics required to obtain RBC and Platelet results.

Table 2.4-1 Technical Characteristics for Obtaining RBC and Platelet Counts

Dilution Characteristics	
Primary Dilution for RBC and Plt:	
Initial volume of whole-blood	10 µL
Volume A^{C}•T 5diff diluent	1700 µL
Primary dilution ratio	1:170
Secondary Dilution for RBC and Plt:	
Volume of primary dilution	42.5 µL
Volume A^{C}•T 5diff diluent	2500 µL
Secondary dilution ratio	1:58.8
Final dilution for RBC and Plt results	1:170 x 1:58.8 = 1:10,000
Reaction temperature	35°C (95°F)
Measurement Characteristics	
Method of analysis	Coulter Principle
Aperture diameter	50 µm
Count vacuum	200 mb (5.9 in. Hg)
Count period	2 x 5 seconds

Parameter Results Obtained from the RBC/Plt Dilution

This final 1:10,000 RBC/Plt dilution is used to:

- Determine the RBC count.
- Develop the RBC histogram, which is needed to obtain the Hct, MCV, and RDW results.
- Determine the Plt count.
- Develop the Plt histogram, which is needed to obtain the MPV, Pct, and PDW results.

Hgb Measurement

Hemoglobin is determined from the dilution in the DIL1/HGB bath (Figure 2.4-1). This dilution is prepared in two stages – the primary (first) dilution and the secondary (last) dilution.

The primary dilution is made and 42.5 µL of that dilution is removed for making the RBC/Plt dilution. A^{C}•T 5diff Hgb Lyse and additional diluent are added to make the final 1:250 dilution.

The Hgb concentration is based on the transmittance of light through the optical part of the DIL1/HGB bath using a spectrophotometric technique at a wavelength of 550 nm. The transmittance of the sample dilution is compared to the transmittance of a reagent blank. The system calculates the Hgb using the blank and sample readings.

Table 2.4-2 summarizes the technical characteristics required for measuring hemoglobin.

Table 2.4-2 Technical Characteristics for the Measurement of the Hemoglobin

Dilution Characteristics	
Volume of whole-blood	10 µL
Volume A^{C}•T 5diff diluent	1700 µL
Preliminary dilution ratio	1:170
Volume of the 1:170 dilution removed (for making the RBC/Plt dilution)	42.5 µL
Additional volume of A^{C}•T 5diff diluent	400 µL
Volume of A^{C}•T 5diff Hgb Lyse	400 µL
Final dilution for Hgb determination	1:250
Reaction temperature	35°C (95°F)
Measurement Characteristics	
Method of analysis	Spectrophotometry
Wavelength	550 nm

WBC Count and Differential

The WBC count is determined twice using two different methodologies:

- The reference WBC count is the count obtained in the WBC/BASO bath (Figure 2.4-2). The WBC count and the BASO count are determined simultaneously.
- A second WBC count is determined in the flow cell during acquisition of the DiffPlot. The dilution analyzed in the flow cell is prepared in the DIFF bath (Figure 2.4-2).

The WBC counts from the two methodologies are compared and if the results exceed the predefined limits, they will be flagged.

Figure 2.4-2 Bath Assembly

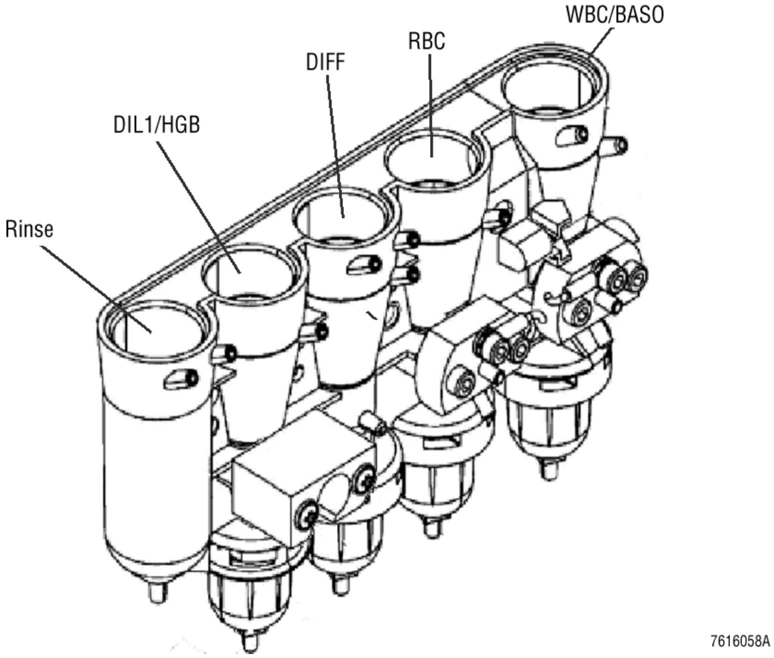


Table 2.4-3 summarizes the technical characteristics required to obtain WBC and BASO results.

Table 2.4-3 Characteristics Required to Obtain WBC and BASO Results

Dilution Characteristics	
Volume of whole-blood	10 µL
Volume A^{C}•T 5diff WBC Lyse	2,000 µL
Dilution ratio	1:200
Reaction temperature	35°C (95°F)
Measurement Characteristics	
Method of analysis	Coulter Principle
Aperture diameter	80 µm
Count vacuum	200 mb (5.9 in. Hg)
Count period	2 x 6 seconds

Parameter Results Obtained from the WBC/BASO Dilution

The final 1:200 dilution is used to:

- Determine the WBC count, and
- Develop the WBC/BASO histogram, which is needed to obtain the BASO count.

Differential

Twenty-five microliters (25 µL) of whole blood is delivered to the DIFF bath in a flow of A^{C}•T 5diff Fix reagent, which lyses the red blood cells, stabilizes the WBC in their native forms, and differentially stains the lymphocytes, monocytes, neutrophils, and eosinophils, with the eosinophils staining most intensely.

The solution is then stabilized with diluent for three seconds and transferred to the measuring bath. See Figure 2.4-3. Each cell is measured in absorbance (cytochemistry) and resistivity (volume).

Figure 2.4-3 Flow Cell Operation

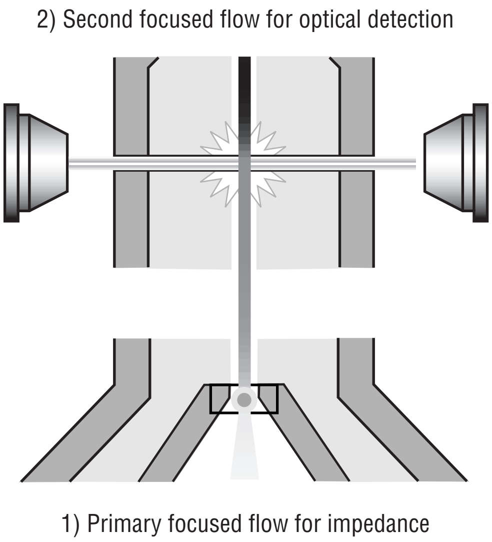

2) Second focused flow for optical detection
1) Primary focused flow for impedance

Table 2.4-4 summarizes the technical characteristics required for acquisition of the DiffPlot.

Table 2.4-4 Technical Characteristics for Acquisition of the DiffPlot

Dilution Characteristics	
Volume of whole-blood	25 µL
Volume A^{C}•T 5diff Fix	1000 µL
Volume A^{C}•T 5diff Diluent	1000 µL
Final dilution ratio	1:80
Reaction temperature	35°C (95°F)
Incubation duration	12 seconds
Measurement Characteristics	
Method of analysis	Impedance with hydrofocus
Aperture diameter	60 µm
Diameter of the flow	42 µm
Volume injected	72 µL
Injection duration	15 seconds
Data accumulation	12 seconds

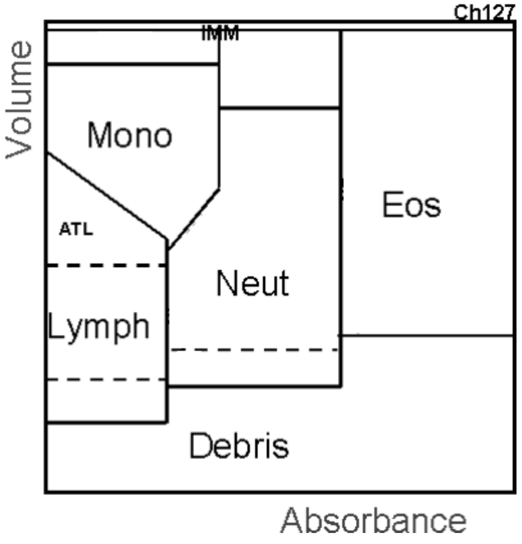
Parameter Results Obtained from the DIFF Dilution

From these measurements, a DiffPlot is developed with optical transmission (absorbance) on the X-axis and volume on the Y-axis. Figure 2.4-4 shows the DiffPlot regions.

From the DiffPlot, four out of five leukocyte (white blood cell) populations are determined: lymphocytes, monocytes, neutrophils, and eosinophils.

In a typical whole-blood sample, the basophil population (determined in the WBC/BASO bath) is very small compared to the other four white blood cell populations.

Figure 2.4-4 DiffPlot Regions



Dilution Summary

Table 2.4-5 summarizes the dilution characteristics required to obtain CBC and CBC/DIFF parameter results.

Table 2.4-5 Summary of Dilutions

Technical Characteristics for	Whole-Blood Volume	Reagent(s)	Reagent Volume	Dilution Ratio	Reaction Temperature
WBC Count and BASO count (in the WBC/BASO bath)	10 µL	AC•T 5diff WBC Lyse	2000 µL	Final 1:200	35°C (95°F)
Differential Acquisition with Differential WBC Count (in the DIFF bath)	25 µL	AC•T 5diff Fix AC•T 5diff Diluent	1000 µL 1000 µL	Final 1:80	35°C (95°F)
Hemoglobin Measurement (in the DIL1/HGB bath)	10 µL	AC•T 5diff Diluent After removing 42.5 µL of the 1:170 dilution: AC•T 5diff Diluent AC•T 5diff Hgb Lyse	1700 µL 400 µL 400 µL	Preliminary 1:170 Final 1:250	35°C (95°F)
RBC and PLT Count (in the RBC bath) **Note:** The primary dilution (1:170) is made in the DIL1/HGB bath.	42.5 µL of the 1:170 dilution (from the DIL1/HGB bath)	AC•T 5diff Diluent	2500 µL	Secondary 1:58.8 1:170 x 1:58.8 = Final 1:10,000	35°C (95°F)

2.5 RBC PARAMETER DEVELOPMENT

RBC/Plt Dilution

The final 1:10,000 dilution in the RBC bath contains red blood cells, white blood cells, and platelets. Thresholds are used to separate the platelet pulses, which are much smaller, from the red and white blood cell pulses. Since white blood cells fall in the red blood cell size range, they are counted and sized as RBCs. The WBCs are not sorted out because any interference is usually insignificant; there are normally very few WBCs (thousands) in comparison to the number of RBCs (millions). Only when the white count is markedly elevated is the red cell count or histogram influenced.

RBC Count

The A^{C}•T 5diff hematology analyzer uses duplicate counting criteria, voting criteria, and proprietary flagging information to confirm the parameter result prior to reporting it. To obtain an RBC count result, the instrument compares the data from the two 5-second count periods then votes and rejects any questionable data.

RBC count = Number of cells counted per volume unit x Calibration factor

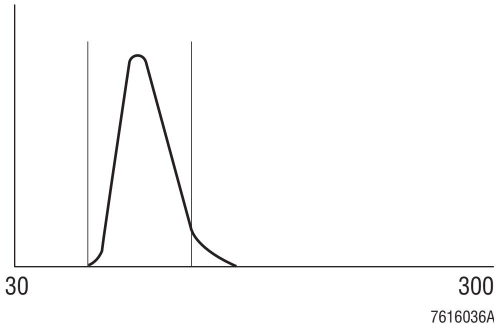
The RBC count is displayed and printed as: RBC = N x 10^6 cells /µL.

Note: Cells per microliter (cells/µL) is the US reporting unit format. See Heading A.7 in the Operator's Guide for the other available formats.

RBC Histogram

In addition to being counted, red blood cells are categorized according to size (from 30 fL to 300 fL) by a 256-channel pulse-height analyzer. The pulse-height analyzer uses a number of thresholds to sort the particles into several size (volume) categories and to develop a size distribution curve of the particles. The RBC distribution curve shows cells in their native size. Figure 2.5-1 is an example of an RBC histogram with a normal RBC size distribution.

Figure 2.5-1 Typical RBC Histogram



Parameter Results Obtained Using the RBC Histogram

Hct Measurement

The height of the pulse generated by the passage of a cell through the aperture is directly proportional to the volume of the analyzed red blood cell. The hematocrit (Hct) is the sum of all the digitized pulses. The Hct is displayed and printed as a percentage (%).

Note: Percentage (%) is the US reporting unit format. See Heading A.7 in the Operator's Guide for the other available formats.

MCV Calculation

The MCV (Mean Cell Volume) is calculated using the Hct and the RBC count. The MCV is displayed and printed in femtoliters (fL).

Note: Femtoliters (fL) is the US reporting unit format. See Heading A.7 in the Operator's Guide for the other available formats.

RDW Calculation

The RDW (Red cell Distribution Width) is an index of the variation or spread in the size of the red blood cells. The study of the RBC distribution detects erythrocyte anomalies linked to anisocytosis and enables the clinician to follow the evolution of the width of the curve relative to the cell number and average volume. Displayed and printed as a percentage, RDW is calculated using the standard deviation (SD) of the RBC population and the MCV.

$$\frac{K\ SD}{MCV} = RDW\ (\%)$$

where:

K = System constant

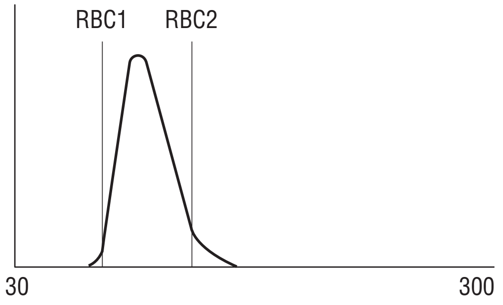
SD = Calculated standard deviation based on the red cell distribution

MCV = Mean Cell Volume of the red cells

RBC Distribution Flags

Once the RBC distribution curve is developed, two positions on the distribution curve are located (Figure 2.5-2):

Figure 2.5-2 RBC1 and RBC2 Positions - RBC Histogram



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RBC1 and RBC2 Thresholds

Thresholds RBC1 and RBC2 define the MICRO and MACRO regions and are calculated based on standard deviation (SD) of the RBC population.

The RBC1 threshold (monitoring area for microcytes) and the RBC2 threshold (monitoring area for macrocytes) identify the points on the curve that are ±2 SD from the mean (Figure 2.5-2).

Flags

Note: MICRO and MACRO flags will be activated in software version 1.0 and higher.

The MICRO flag is generated when the percentage of cells in the microcytic region compared to the total number of RBCs exceeds the preset default limit of 5%. The MACRO flag is generated when the percentage of cells in the macrocytic region compared to the total number of RBCs exceeds the preset default limit of 7.5%. A laboratory may establish its own limits to replace the preset default values.

Note: The MICRO and MACRO flags are independent of the Microcytosis and Macrocytosis flags that are generated from the Low and High patient limits.

Hgb Determination

The hemoglobin (Hgb) released by the lysis of the red blood cells combines with the potassium cyanide to form a stable cyanmethemoglobin compound.

This compound is measured through the optical part of the DIL1/HGB bath using a spectrophotometric technique at a wavelength of 550 nm. Transmittance of the sample dilution is compared with the transmittance of a reagent blank. The system calculates the Hgb using both the blank and sample readings.

The final Hgb result in g/dL represents: absorbance value obtained x Calibration factor.

Hgb is displayed and printed as: Hgb = N g/dL.

Note: Grams per deciliter (g/dL) is the US reporting unit format. See Heading A.7 in the Operator's Guide for the other available formats.

Hgb Blank Reading

The Hgb blank value measured during the first patient cycle after a Startup cycle is stored as a reference blank. This blank must be greater than 2.5 Vdc. During each analysis cycle, the instrument checks the measured Hgb blank against the stored Hgb blank reference value using the following formula:

$$(\text{Blank}^{\text{Ref}} \times 1/3) + (\text{Blank}^{\text{S}} \times 2/3) = \text{Blank}^{\text{NR}}$$

where:

$\text{Blank}^{\text{Ref}}$ = Hgb blank reference value

Blank^{S} = Hgb blank value from the current cycle

Blank^{NR} = New Hgb blank reference value for comparison

Note: If the new Hgb blank reference value is within 3% of the old reference value, the Hgb blank reference value is changed to this new value.

Sample Reading

This value is based on the sample, diluent, and Hgb Lyse reagent mixture in the DIL1/HGB bath during sample measurement.

Hgb Specific Flags

If the Hgb blank value is less than 2.5 Vdc, a reject (R) flag occurs on the Hgb value.

If the difference between the new Hgb blank reference value and the original Hgb blank reference value is greater than 3%, a review (R) flag is generated. If three consecutive review (R) flags occur on the Hgb blank reference value, the (· · · · ·) code replaces the Hgb result.

For each Hgb sample read value, the instrument takes three readings. If the difference between these readings exceeds the predefined limits (default setting is 60 A to D units), a voteout (V) flag is generated.

MCH and MCHC Calculations

MCH Calculation

The MCH (Mean Cell Hemoglobin) is calculated from the Hgb value and the RBC count and describes the average weight of hemoglobin in a red cell. The calculation for MCH is:

$$\frac{\text{Hgb}}{\text{RBC}} \times 10 = \text{MCH (pg)}$$

Note: Picograms (pg) is the US reporting unit format. See Heading A.7 in the Operator's Guide for the other available formats.

MCHC Calculation

The MCHC (Mean Cell Hemoglobin Concentration) is calculated using the Hgb and Hct values and describes the average concentration of hemoglobin in the red blood cells. The calculation for MCHC is:

$$\frac{\text{Hgb}}{\text{Hct}} \times 100 = \text{MCHC (g/dL)}$$

Note: Grams per deciliter (g/dL) is the US reporting unit format. See Heading A.7 in the Operator's Guide for the other available formats.

2.6 PLATELET PARAMETER DEVELOPMENT

RBC/Plt Dilution

Platelet counting and sizing is also done in the RBC bath. Thresholds separate the platelet pulses, which are much smaller, from the red and white blood cell pulses.

Plt Count

The A^{C}•T 5diff hematology analyzer uses duplicate counting criteria, voting criteria, and proprietary flagging information to confirm the parameter result prior to reporting it. To obtain a Plt count result, the instrument compares the data from the two 5-second count periods then votes and rejects any questionable data.

Plt count = Number of cells counted per volume unit x Calibration factor.

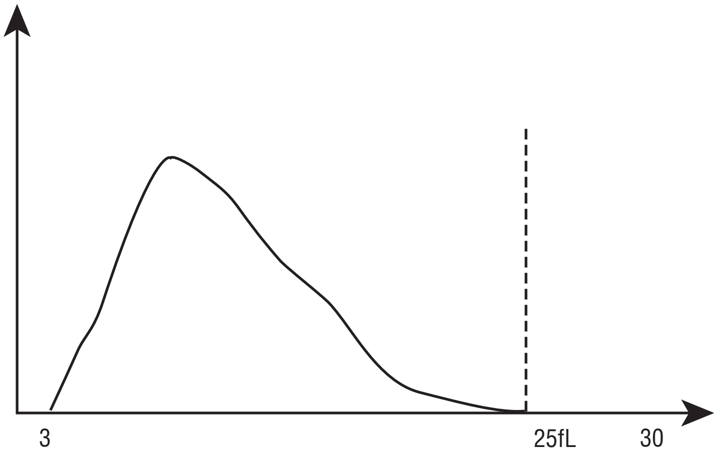
The Plt count is displayed and printed as: Plt = N x 10^3 cells /µL.

Note: Cells per microliter (cells/µL) is the US reporting unit format. See Heading A.7 in the Operator's Guide for the other available formats.

Platelet Distribution Curve

Platelets are categorized according to size by a 256-channel pulse-height analyzer. A pulse-height analyzer uses a number of thresholds to sort the particles into several size (volume) categories and to develop a size distribution curve of the particles between 2 fL and 30 fL. The Plt distribution curve shows cells in their native size. Figure 2.6-1 is an example of a Plt histogram with a normal Plt size distribution.

Figure 2.6-1 Typical Plt Histogram



Parameter Results Obtained Using the Plt Histogram

MPV Measurement

The MPV (Mean Platelet Volume) is measured directly from analysis of the platelet distribution curve. The MPV is displayed and printed in femtoliters (fL).

Note: Femtoliters (fL) is the US reporting unit format. See Heading A.7 in the Operator's Guide for the other available formats

Pct Calculation

The Pct (plateletcrit or thrombocrit) is calculated according to the formula:

$$\frac{\text{Plt }(10^3/\mu\text{L}) \times \text{MPV (fL)}}{10,000} = \text{Pct\%}$$

The Pct parameter result is displayed and printed as a percentage (%).

PDW Calculation

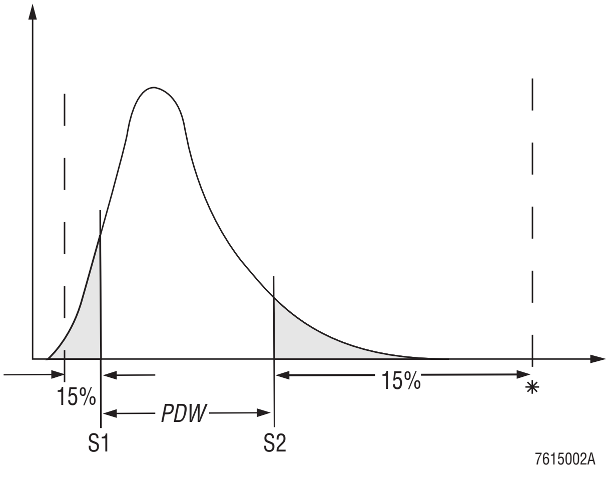
PDW (Platelet Distribution Width) is calculated from the Plt histogram as the width of the curve between S1 and S2.

As shown in Figure 2.6-2, S1 and S2 are placed so that:

- 15% of the platelets occur between 2 fL and S1.
- 15% of the platelets occur between S2 and the variable upper threshold.

  Note: This threshold is explained under the Detecting Abnormal Platelet Distributions heading that follows.
- The PDW result is determined on the platelets between S1 and S2.

Figure 2.6-2 Area of the Plt Histogram Used to Determine the PDW Parameter Result



The PDW parameter result is displayed and printed as a percentage (%).

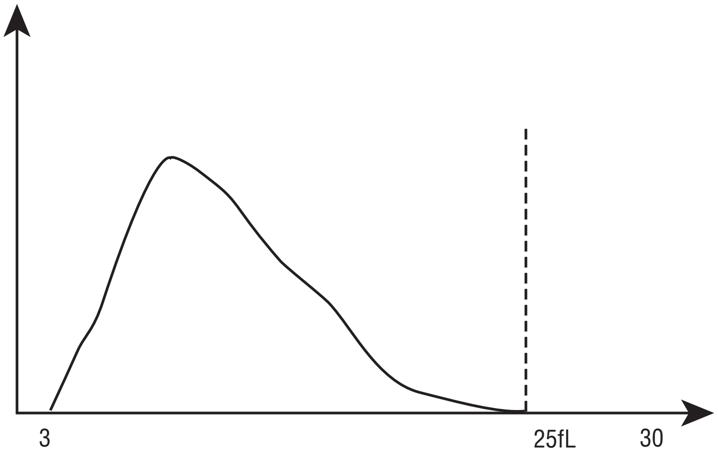
Detecting Abnormal Platelet Distributions

Particles of approximately platelet size can interfere with the platelet histogram and count. Small particles, such as microbubbles or dust, can overlap the low end. Microcytic red cells can intrude at the upper end.

Identifying a Normal Distribution

When a platelet histogram is being evaluated, a mobile threshold can move from its starting position at 25 fL to 18 fL (Figure 2.6-3). The computer searches for a valley between the platelet and red cell populations. If no valley is detected between 18 fL and 25 fL, the threshold remains at 25 fL and no flag is generated.

Figure 2.6-3 Typical Platelet Distribution Curve



Interference on the Lower End of the Platelet Distribution Curve

Particles that are approximately platelet size can interfere with the platelet histogram and count. Small particles, such as microbubbles or dust, can interfere at the low end. If the number of pulses in the 2 to 3 fL region is higher than the predefined limits, an SCL flag appears to alert the operator that a significant number of small cells or interference, such as microbubbles, are present.

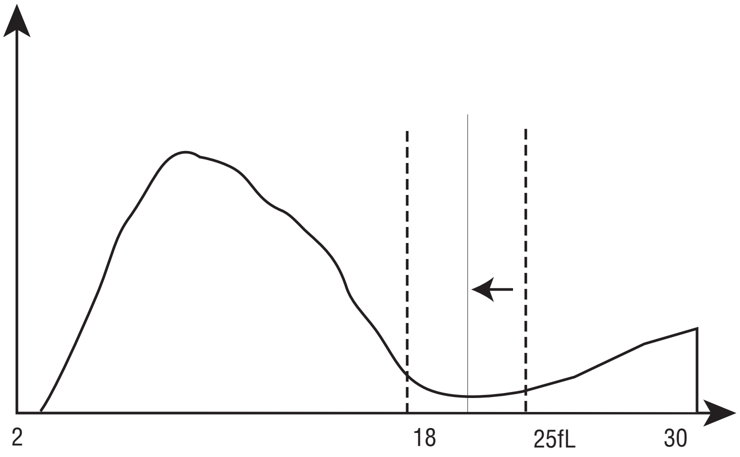
Microcytic Interferences on the Upper End of the Platelet Distribution Curve

Microcytic red cells can intrude at the upper end of the platelet distribution curve. If the specimen contains microcytes, the A^{C}•T 5diff analyzer may be able to successfully eliminate the influence of this interference by repositioning the variable threshold (25 fL threshold) and excluding the microcytes.

Microcytic Interference with a Distinct Valley between 18 fL and 25 fL

If the intrusion of microcytes creates a valley between the 25 fL and the 18 fL thresholds (Figure 2.6-4). The 25 fL threshold is repositioned at the valley to minimize interference to the platelet parameter results. Therefore, the reported platelet results are acceptable. The MIC (microcytes) flag appears to alert the operator that microcytes are present.

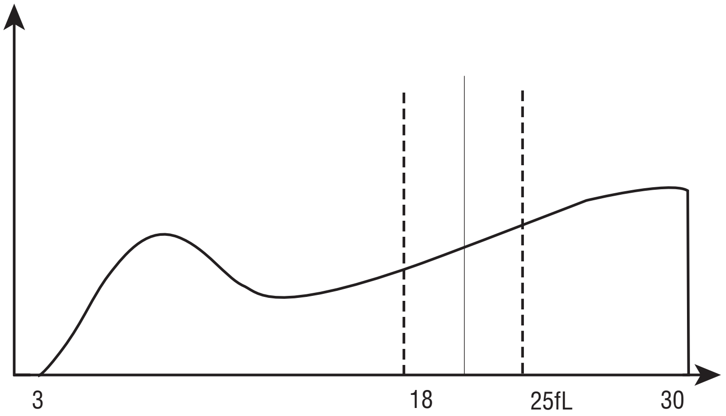
Figure 2.6-4 Microcytic Interference with a Valley between 18 fL and 25 fL



Microcytic Interference with a Valley below 18 fL

If the microcytes are extremely small so that the valley between the platelet population and the microcyte population falls below the 18 fL limit, the threshold is placed at the 18 fL limit (Figure 2.6-5). The MIC flag appears and the platelet count is flagged to alert the operator that the extremely small microcytes present in this sample could not be eliminated. The platelet count and associated parameters are not reliable and should be verified by an alternative method. To effectively eliminate the microcytes, the Operator's Guide suggests the customer use platelet rich plasma (PRP) or a manual count to verify the results.

Figure 2.6-5 Microcytic Interference with a Valley below 18 fL

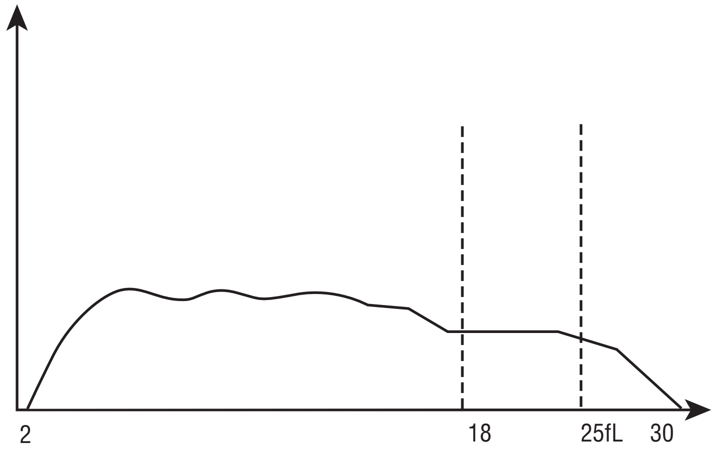


Interference with No Distinct Valley

Interference present in the upper area of the platelet distribution curve that blends with the platelet population so that there is no clear distinction between the platelets and the interference suggest the presence of schistocytes (fragmented red cells) or platelet aggregates (platelet clumps).

If the threshold cannot be positioned in the 25 fL to 18 fL region, the threshold defaults to the 18 fL position (Figure 2.6-6). The SCH (schistocytes) flag appears and the platelet count is flagged to alert the operator that the interference (which is most likely either schistocytes or platelet clumps) could not be eliminated. The platelet count and associated parameters are not reliable and must be verified using an alternative method.

Figure 2.6-6 Interference with no Distinct Valley



2.7 WBC PARAMETER DEVELOPMENT

Overview

WBC parameter results are generated from two different dilutions: the 1:200 WBC/BASO dilution which is made and analyzed in the WBC/BASO bath and the 1:80 DIFF dilution which is made in the DIFF bath but analyzed in the flow cell.

WBC/BASO Dilution

The WBC and basophil counts are determined from the 1:200 dilution made in the WBC/BASO bath. To make this dilution, 10 µL of whole blood is mixed with 2,000 µL of A^{C}•T 5diff WBC Lyse reagent. The reaction that occurs lyses the red blood cells and specifically differentiates between basophils and other leukocytes by volume.

WBC Count

The A^{C}•T 5diff hematology analyzer uses duplicate counting criteria, voting criteria, and proprietary flagging information to confirm the parameter result prior to reporting it. To obtain an WBC count result, the instrument compares the data from the two 5-second count periods then votes and rejects any questionable data. This is the reference WBC count, which is also the count reported.

A second WBC count is determined in the flow cell during acquisition of the DiffPlot. The two counts are compared and if they differ more than the predefined limit, a flag occurs.

WBC count: Number of cells per volume x calibration factor.

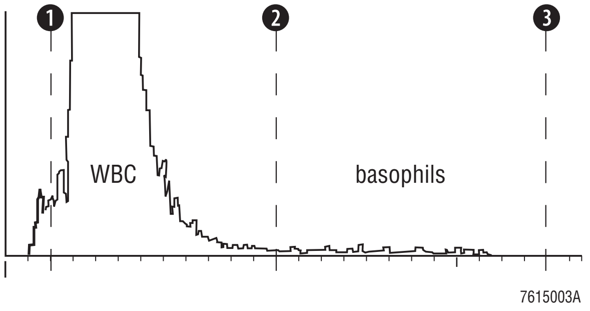
The WBC count is displayed and printed as: WBC = N x 10^3 cells /µL.

Note: Cells per microliter (cells/µL) is the US reporting unit format. See Heading A.7 in the Operator's Guide for the other available formats.

BASO Count

Differentiation between basophils and other leukocytes is obtained by means of the A^{C}•T 5diff WBC Lyse-specific lytic action. See Figure 2.7-1.

Figure 2.7-1 Areas Used to Determine WBC and BASO Parameter Results



In Figure 2.7-1, basophils are located in the area between the thresholds labeled ❷ and ❸. One hundred percent (100%) of the leukocytes is represented by the total number of nucleated particles plus the basophils within the area between the thresholds labeled ❶ and ❸.

The basophil percentage is calculated from the number of particles existing in the area between the thresholds labeled ❷ and ❸ (Figure 2.7-1)

BASO count = Number of cells per volume x calibration factor in a percentage relative to the number of counted cells (basophils plus other WBC nuclei).

$$\text{BASO count} = \frac{\text{BASO\%}}{\text{WBC\%}} \times \text{WBC count}$$

DIFF Dilution

The data for the DiffPlot is accumulated as the dilution made in the DIFF bath is injected into the flow cell. To make the 1:80 DIFF dilution, 25 µL of the whole-blood sample is mixed with 1,000 µL of A^{C}•T 5diff Fix reagent. The Fix reagent lyses the red blood cells, stabilizes the the white blood cells, and differentially stains the lymphocytes, monocytes, neutrophils, and eosinophils, with the eosinophils staining most intensely. After 12 seconds of incubation, 1,000 µL of A^{C}•T 5diff Diluent reagent is added to stop the cytochemical reaction. This dilution is injected through the flow cell 15 seconds. For 12 of these 15 seconds, data for developing the DiffPlot is accumulated.

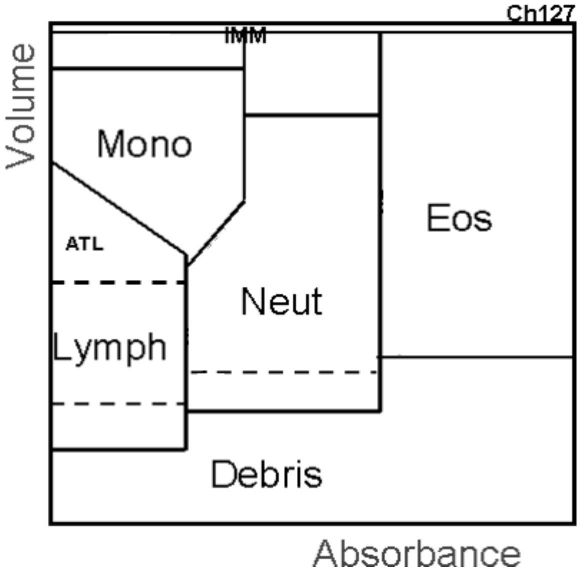
DiffPlot Development

The DiffPlot analysis on the A^{C}•T 5diff hematology analyzer is based on three essential principles:

- Dual Focused Flow (DFF) fluid dynamics, which is a process by which individual cells or particles are focused in a stream of diluent (hydrodynamic focusing).
- The volume measurement (Coulter Principle).
- The measurement of transmitted light with zero degree (0°) angle, which permits a response proportional to the internal structure of each cell and its absorbance.

From these measurements, a DiffPlot is developed with optical transmission (absorbance) on the X-axis and volume on the Y-axis. Figure 2.7-2 shows the DiffPlot regions.

Figure 2.7-2 DiffPlot Regions



DiffPlot Regions Defined

The study of the DiffPlot permits the clear differentiation of four out of five leukocyte populations. In a typical whole-blood sample, the basophil population is very small when compared with the other four white cell populations.

Neutrophil (Neut)

Neutrophils, with their cytoplasmic granules and segmented nuclei, scatter light according to their morphological complexity. A hypersegmented neutrophil gives an increased optical response when compared to a young neutrophil population. The higher the complexity of the cell, the further to the right they appear in the DiffPlot (Figure 2.7-2).

Lymphocyte (Lymph)

Lymphocytes, typically being small with regular shape are smaller in volume and lower in absorbance than the other cells, and are positioned in the lower region of the DiffPlot (Figure 2.7-2). Normal lymphocyte populations typically have a homogeneous volume with a Gaussian (bell-shaped) distribution.

Large lymphocytes, reactive lymphoid forms, stimulated lymphocytes and plasma cells are found in the upper portion of the lymphocyte region (Figure 2.7-2).

The lower area of the lymphocyte zone is normally empty; however, when small lymphocytes are present, a population may exist in this area (Figure 2.7-2).

The presence of platelet aggregates is indicated by a distribution pattern that moves from the DiffPlot origin into the lymphocyte region (Figure 2.7-2).

NRBC cytoplasmic membranes lyse like those of mature erythrocytes. The small nuclei that remain appear in the debris and small lymphocyte regions (Figure 2.7-2).

Monocyte (Mono)

Monocytes are typically large cells with a kidney-shaped nucleus and agranular (granule-free) cytoplasm. These cells neither scatter nor absorb large amounts of light and, therefore, are positioned in the lower end of the absorbance axis. Due to their size, the monocytes are clearly positioned high on the volume axis (Figure 2.7-2).

Very large monocytes may be found in the IMM (immature cell) region.

Eosinophil (Eos)

With the reagent action, eosinophils are the most intensely stained cells for optical separation. Due to the staining and their size, the eosinophils will show higher absorbance than the neutrophils, but will be of similar volume (Figure 2.7-2).

Debris

Platelets and debris from erythrocyte lysis represent the background debris population located in the lower region of the DiffPlot.

Immature White Blood Cells

Immature Granulocytes

Immature granulocytes are detected by their larger volume and by the presence of granules that increase the intensity of the scattered light.

Due to their increased volume and similar absorbance, promyelocytes, myelocytes, and metamyelocytes are located above the neutrophil population and are typically counted as IMM cells. IMM cells are included in the reported neutrophil value.

Band Cells

Band cells are typically larger or of similar size to the neutrophils; however, due to their low level of cellular complexity, they absorb less light. As a result, band cells tend to appear in the region between the neutrophils and the monocytes.

Blast Cells

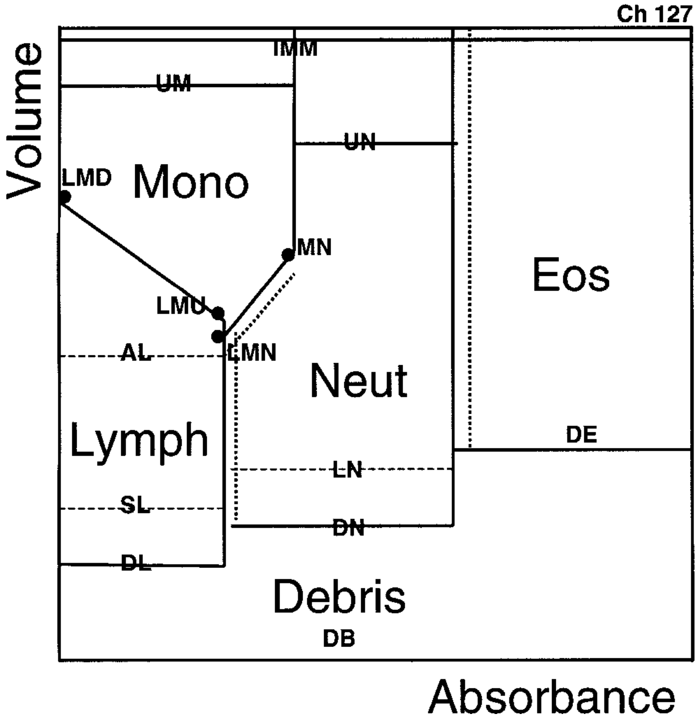
Blast cells are generally larger than monocytes and have similar absorbance. When blast cells are present, they are generally located above the monocytes, which means they will be included in the IMM cell count.

Small blasts will be located between the normal lymphocyte and monocyte populations.

DiffPlot Thresholds

Most of the population partition thresholds are fixed and give the limits of the morphological normality of leukocytes. Changes in the morphology of a population are expressed on the DiffPlot by a shifting of the corresponding population. Volume and absorbance thresholds are used to detect shifting populations. Volume thresholds and definitions are shown in Figure 2.7-3. Absorbance thresholds and definitions are shown in Figure 2.7-4. The NL, NE and MN alarms are also included in Figure 2.7-4.

Figure 2.7-3 Volume Thresholds



DL Threshold - Separates debris and small lymphocytes.

DN Threshold - Separates debris and lower neutrophils.

SL Threshold - Separates small lymphocytes and lymphocytes.

LN Threshold - Separates neutrophils and lower neutrophils.

DE Threshold - Separates debris and eosinophils.

LMN Threshold - Intersection point between the lymphocyte, monocyte, and neutrophil thresholds.

AL Threshold - Separates lymphocytes and atypical lymphocytes.

LMU Threshold - Lower point on the separation slope between atypical lymphocytes and monocytes.

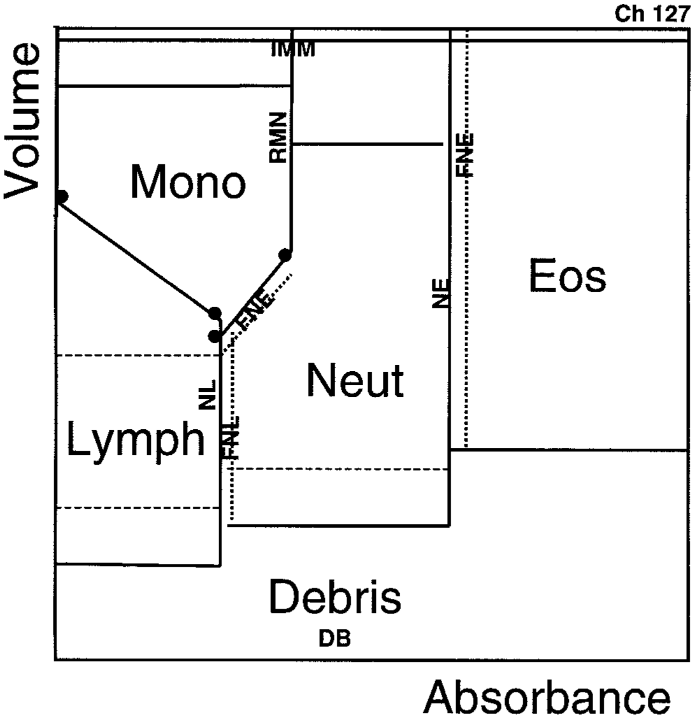
LMD Threshold - Upper point on the separation slope between atypical lymphocytes and monocytes.

MN Threshold - Upper point on the separation slope between monocytes and neutrophils.

UM Threshold - Separates monocytes and upper monocytes.

UN Threshold - Separates neutrophils and upper neutrophils.

Figure 2.7-4 Absorbance Thresholds / NL, NE and MN Alarms


Ch 127
IMM
RMN
FNE
Mono
Volume
FNE
NE
Eos
Neut
NL
FNL
Lymph
Debris
DB
Absorbance

NL Threshold - Separates lymphocytes and neutrophils.

RMN Threshold - Separates upper monocytes and upper neutrophils.

NE Threshold - Separates neutrophils and eosinophils.

NL, NE and MN Alarms

FNL - # of channels for NL alarm area.

FNE - # of channels for NE alarm area.

FMN - # of channels for MN alarm area.

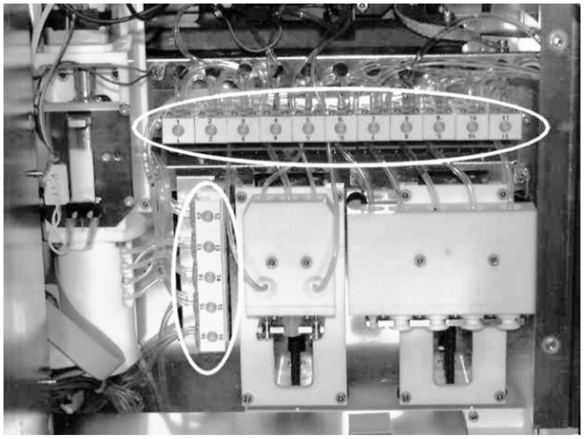
2.8 PNEUMATIC/HYDRAULIC SYSTEM

Functions of Valves

Valve blocks are located close to the elements concerned. Five different blocks:

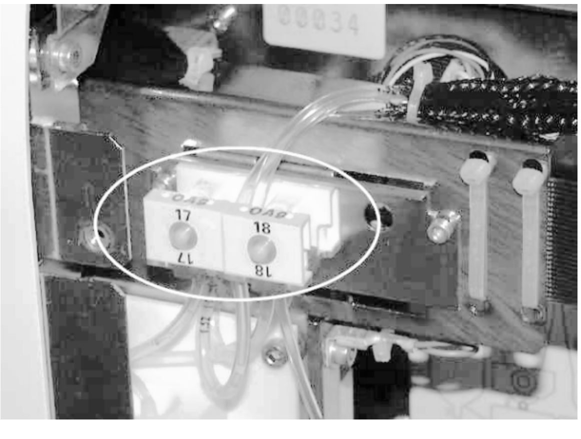
- Valves 1 to 11 (Figure 2.8-1):
  - In the left side compartment behind the Main card,
  - Horizontal block,
  - Above the 5diff syringe and reagent syringes assembly.
- Valves 12 to 16 (Figure 2.8-1):
  - In the left side compartment behind the Main card,
  - Vertical block,
  - Beside the count syringe.

Figure 2.8-1 Valve 1 through Valve 16 Locations



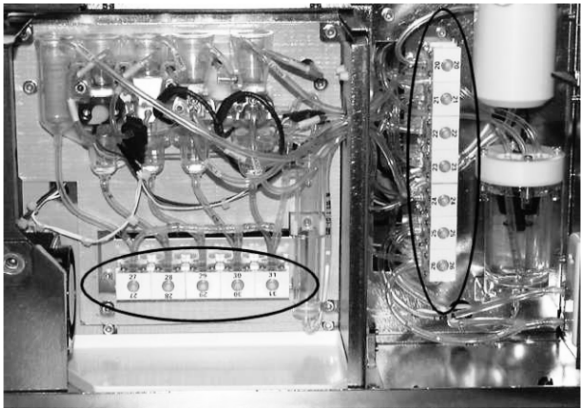
- Valves 17 to 18 (Figure 2.8-2):
  - In the right side compartment,
  - Horizontal block,
  - At the top of the vertical traverse (above the sample syringe assembly).

Figure 2.8-2 Valve 17 and 18 Location



- Valve 19 is not used on the A^{C}•T 5diff hematology analyzer.
- Valves 20 to 26 (Figure 2.8-3):
  - In the right side compartment,
  - Vertical block,
  - Beside the waste syringe.
- Valves 27 to 31 (Figure 2.8-3):
  - In the right side compartment (bath enclosure area),
  - Horizontal block,
  - Below the baths assembly.

Figure 2.8-3 Valve 20 to Valve 31 Locations



See Table 2.8-1 for a description of the functions for each valve in the A^{C}•T 5diff hematology analyzer.

Table 2.8-1 Valves and their Functions

Valve	Function	Action
1	Differential diluent	Select flow cell sheath 2 / DIFF bath
2	Differential diluent	Select flow cell sheath 1 / sheath 2
3	Differential diluent	Select input/output for flow cell Diluent syringe
4	Flow cell sample supply	Opens pathway from the DIFF bath to the flow cell
5	Flow cell sample injector	Opens waste path for sample injector syringe
6	Hgb Lyse syringe flow	Selects input/output of Hgb Lyse syringe
7	Rinse syringe flow	Selects input/output of Rinse syringe
8	Fix syringe flow	Selects input/output of Fix syringe
9	Diluent syringe flow	Selects input/output of Diluent syringe
10	Diluent output control	Routes diluent to probe rinse block or heating coil
11	WBC Lyse syringe flow	Selects input/output of WBC Lyse syringe
12	Rinse output control	Selects rinse to probe rinse block or WBC/BASO bath
13	Count syringe vent	Opens vent line of count syringe
14	RBC/PLT count valve	Opens vacuum count line for RBC bath
15	Diluent reservoir vent	Selects between vacuum and vent for diluent reservoir
16	Count syringe drain	Opens count syringe drain path
17	Probe rinse drain	Opens drain line for probe rinse block
18	Probe diluent	Routes diluent/rinse to sample syringe or rinse block
19	Spare	Not used
20	Waste syringe vent	Opens waste vent (through the rinse chamber)
21	Sweep flow diluent	Routes diluent to heating coil or sweep flow
22	Diluent bath select	Route diluent (via heating coil) to Hgb or RBC bath
23	WBC/BASO count vacuum	Routes vacuum direct or through RBC/PLT count head
24	Flow cell drain	Opens path from flow cell output to DIFF bath for drain
25	Diluent reservoir input	Opens diluent source to diluent reservoir
26	Waste syringe control	Selects waste to syringe / syringe waste out
27	Rinse chamber drain	Opens drain path from rinse chamber
28	HGB bath drain	Opens drain path from Hgb bath
29	DIFF bath drain	Opens drain path from the DIFF bath
30	RBC bath drain	Opens drain path from the RBC bath
31	WBC/BASO bath drain	Opens drain path from WBC/BASO bath drain

Pneumatic Diagrams

To locate the pneumatic diagram for a desired reagent or the waste circuit, see the designated figure:

- For the Hgb Lyse reagent circuit, see Figure 2.8-4.
- For the Fix reagent circuit, see Figure 2.8-5.
- For the WBC Lyse reagent circuit, see Figure 2.8-6.
- For the Rinse reagent supply circuit, see Figure 2.8-7.
- For the Probe Rinse reagent circuit, see Figure 2.8-8.
- For the WBC/BASO Rinse reagent circuit, see Figure 2.8-9.
- For the Diluent reagent circuit, see Figure 2.8-10.
- For the Probe Diluent reagent circuit, see Figure 2.8-11.
- For the Bath Diluent reagent circuit, see Figure 2.8-12.
- For the waste circuit, see Figure 2.8-13.

Figure 2.8-4 Hgb Lyse Reagent Circuit

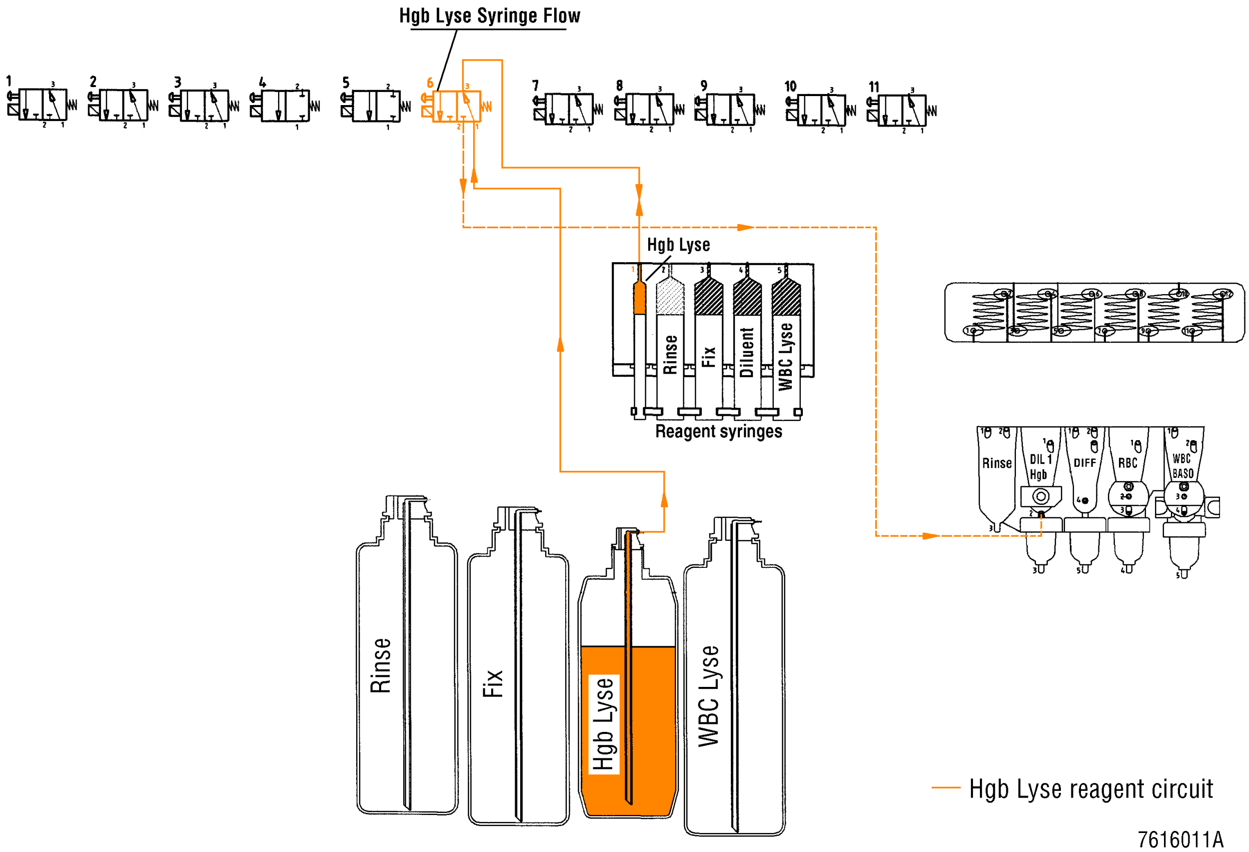

Hgb Lyse Syringe Flow
1
2
3
4
5
6
7
8
9
10
11
Hgb Lyse
Rinse
Fix
Diluent
WBC Lyse
Reagent syringes
Rinse
DIL 1 Hgb
DIFF
RBC
WBC BASO
Rinse
Fix
Hgb Lyse
WBC Lyse
Hgb Lyse reagent circuit
7616011A

Figure 2.8-5 Fix Reagent Circuit

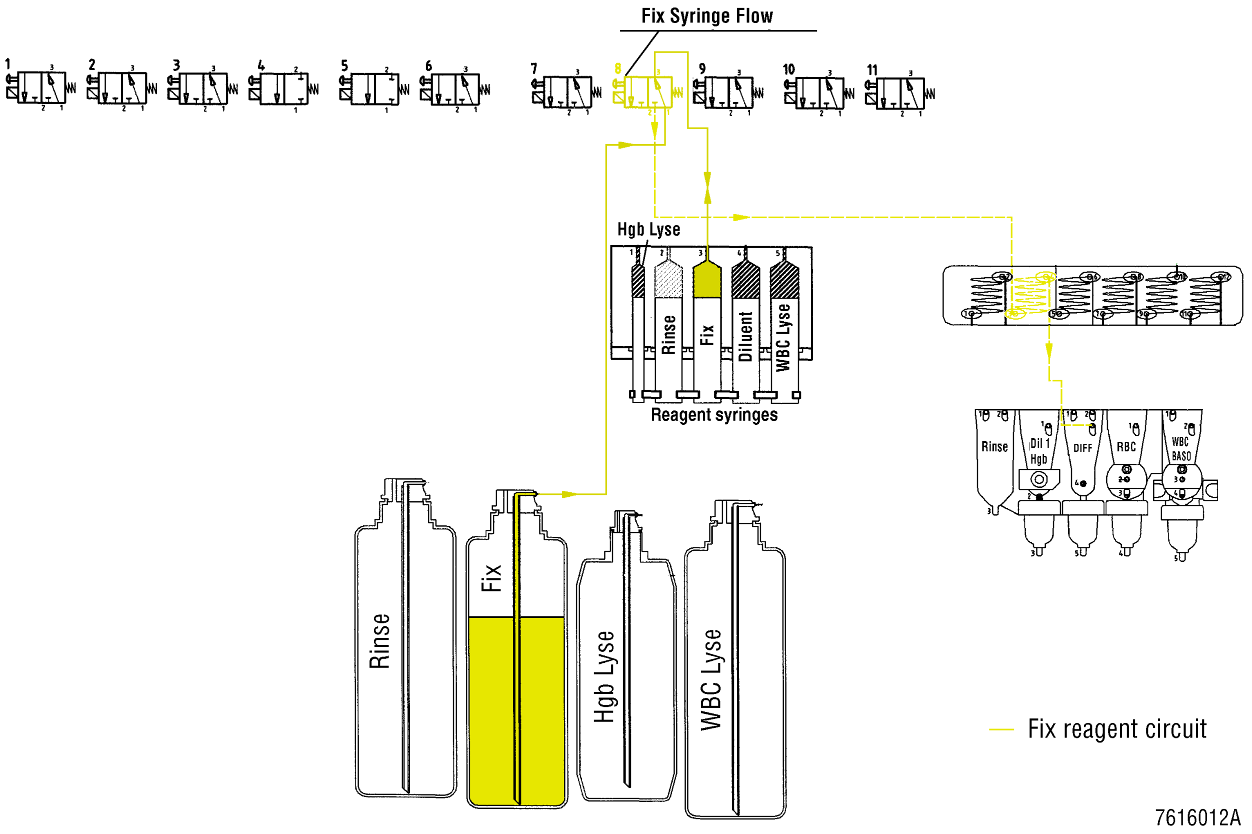
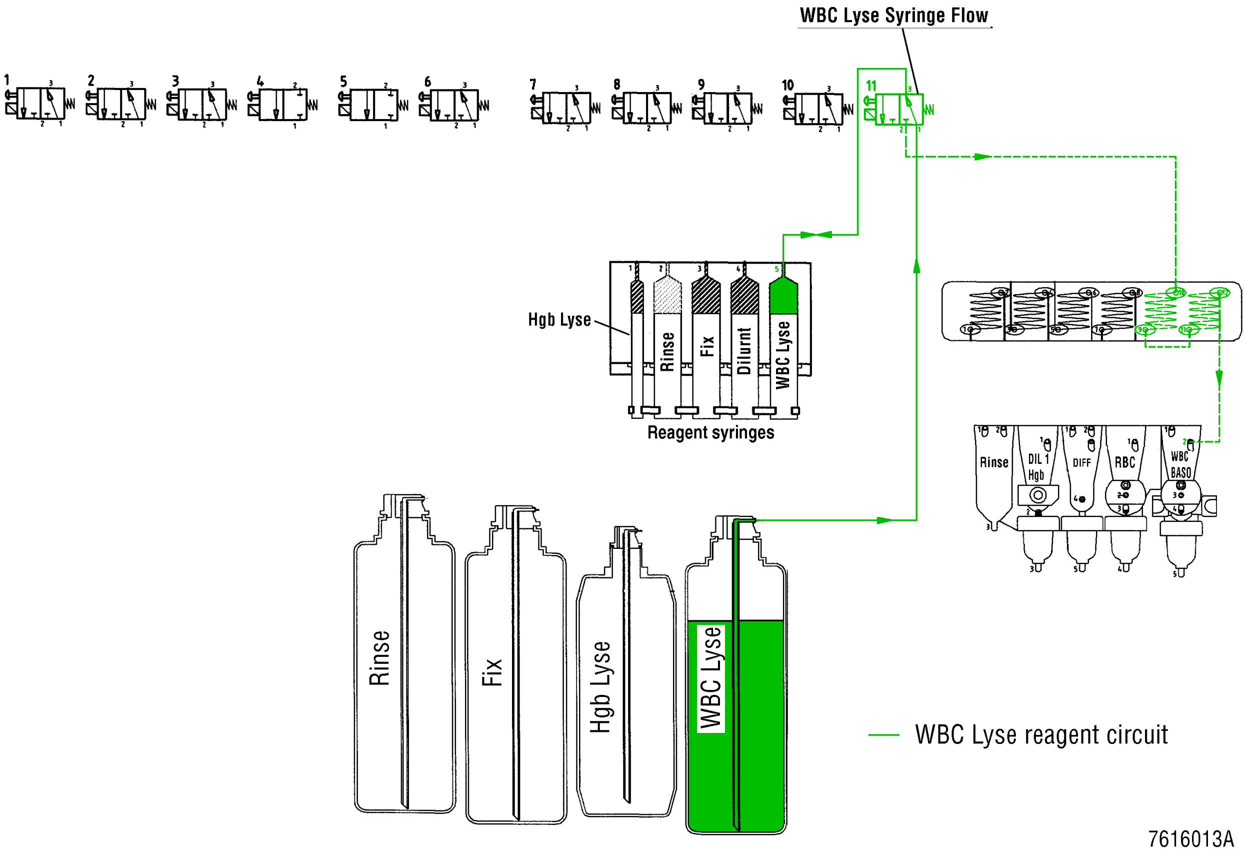

Fix Syringe Flow
1
2
3
4
5
6
7
8
9
10
11
Hgb Lyse
Rinse
Fix
Diluent
WBC Lyse
Reagent syringes
Rinse
Dil 1
Hgb
DIFF
RBC
WBC
BASO
Rinse
Fix
Hgb Lyse
WBC Lyse
— Fix reagent circuit
7616012A

Figure 2.8-6 WBC Lyse Reagent Circuit


WBC Lyse Syringe Flow
1
2
3
4
5
6
7
8
9
10
11
Hgb Lyse
Rinse
Fix
Dilurnt
WBC Lyse
Reagent syringes
Rinse
DIL 1 Hgb
DIFF
RBC
WBC BASO
Rinse
Fix
Hgb Lyse
WBC Lyse
— WBC Lyse reagent circuit

7616013A

Figure 2.8-7 Rinse Reagent Supply Circuit

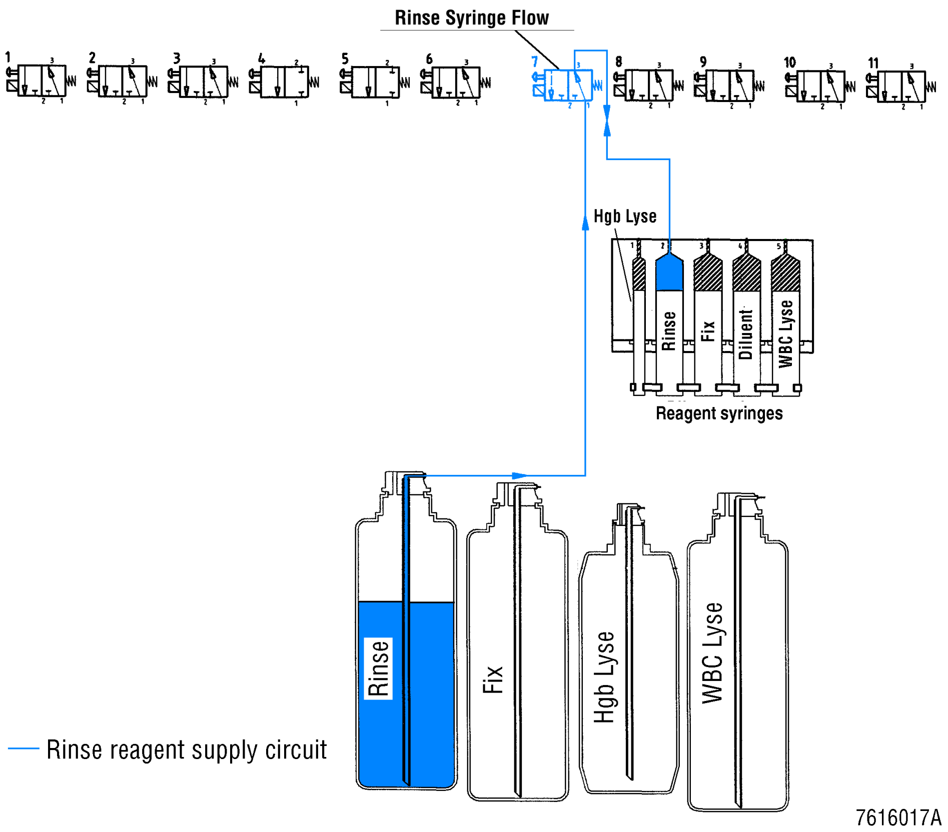

Rinse Syringe Flow
1
2
3
4
5
6
7
8
9
10
11
Hgb Lyse
Rinse
Fix
Diluent
WBC Lyse
Reagent syringes
Rinse
Fix
Hgb Lyse
WBC Lyse
Rinse reagent supply circuit
7616017A

Figure 2.8-8 Probe Rinse Reagent Circuit

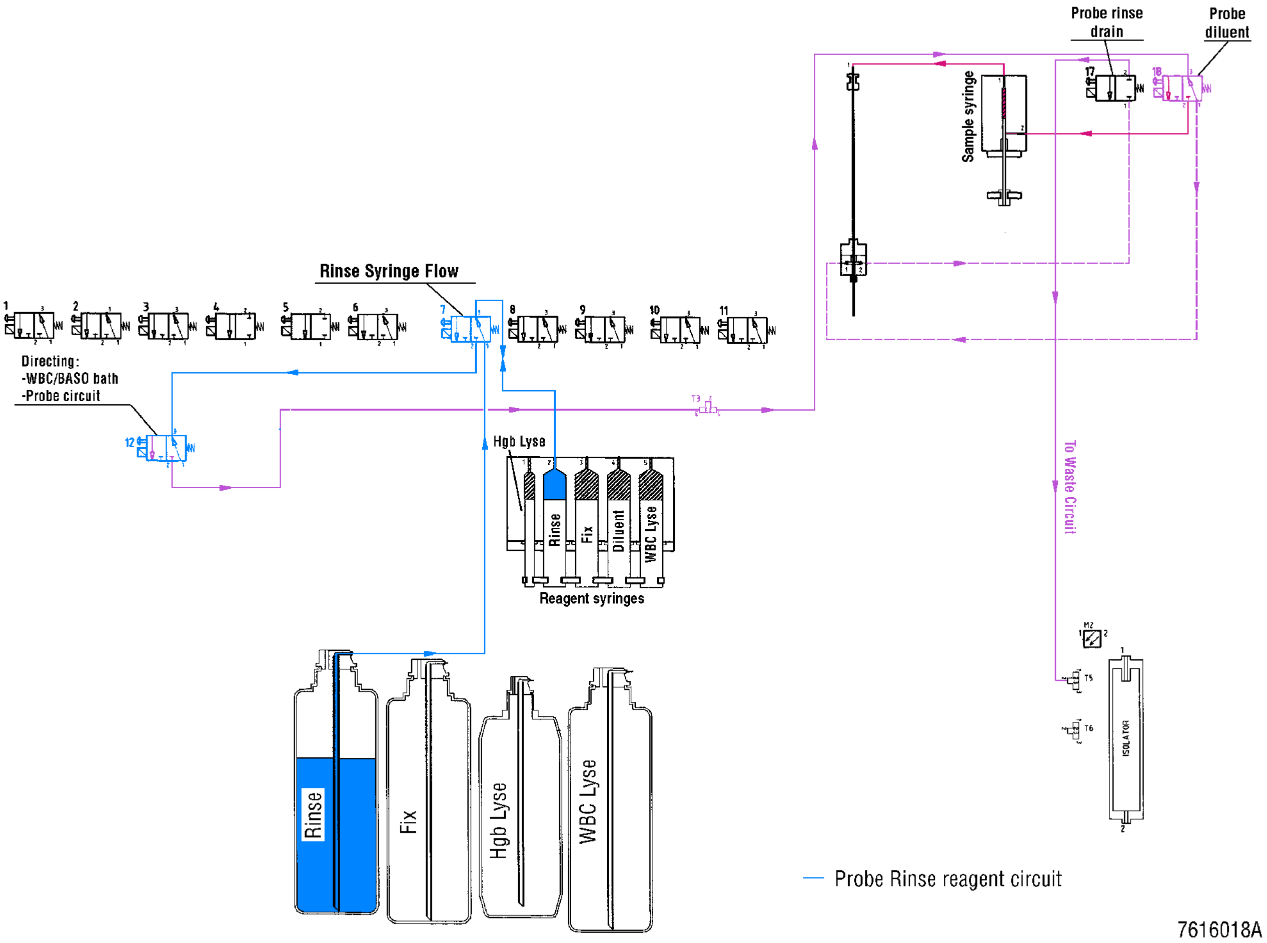
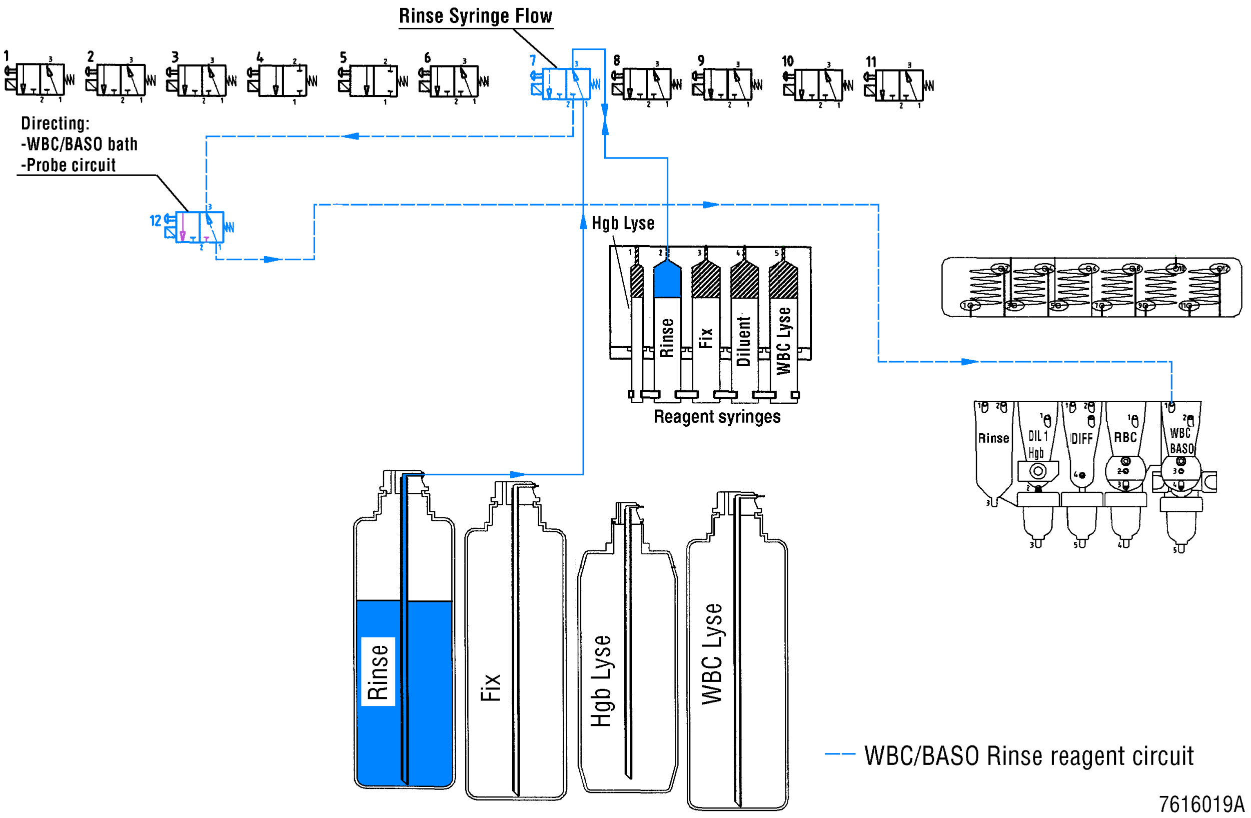

Probe rinse drain
Probe diluent
Sample syringe
17
18
Rinse Syringe Flow
1
2
3
4
5
6
7
8
9
10
11
Directing:
-WBC/BASO bath
-Probe circuit
12
T3
Hgb Lyse
Rinse
Fix
Diluent
WBC Lyse
Reagent syringes
To Waste Circuit
M2
T5
T6
ISOLATOR
Rinse
Fix
Hgb Lyse
WBC Lyse
— Probe Rinse reagent circuit
7616018A

Figure 2.8-9 WBC/BASO Rinse Reagent Circuit

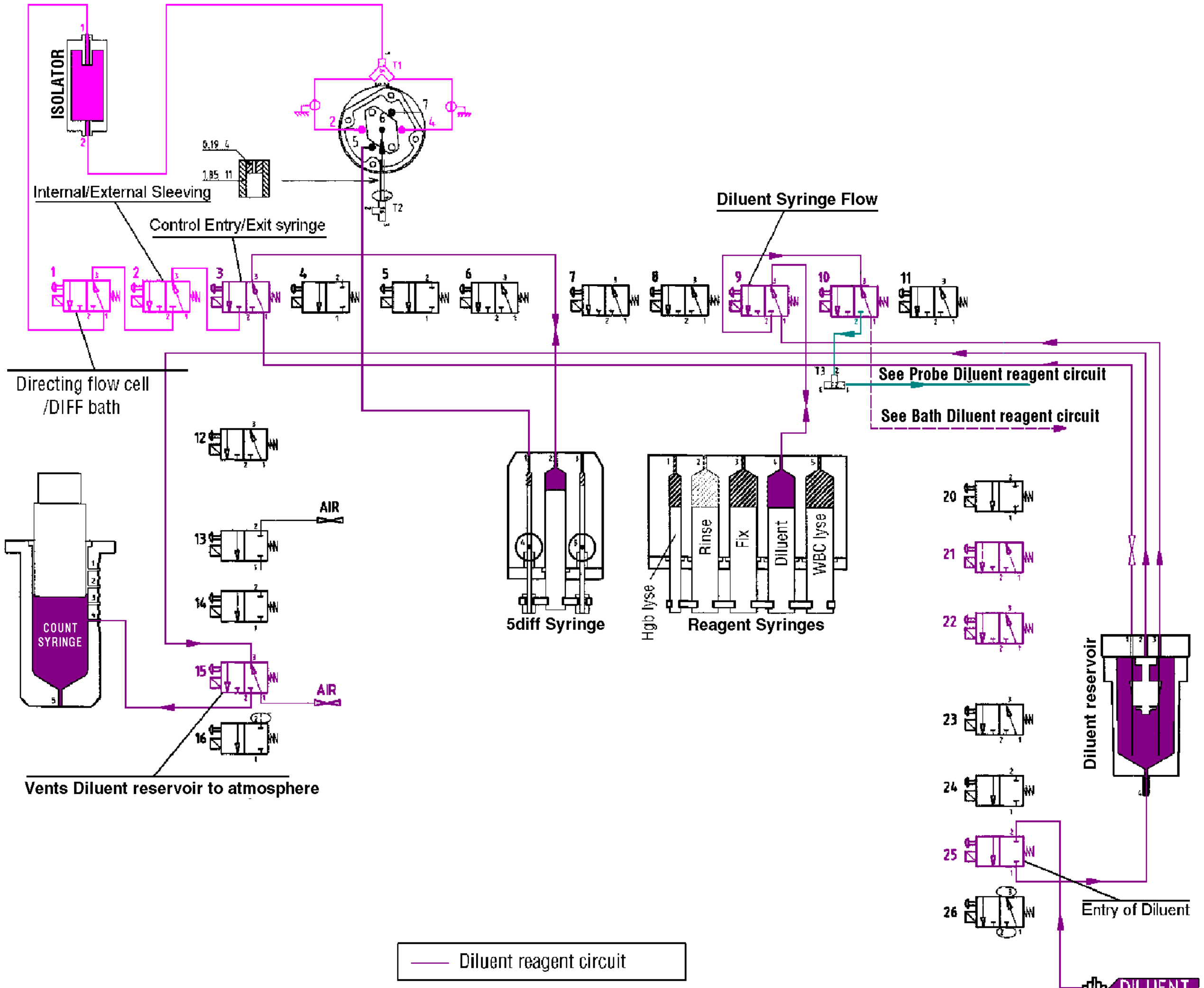

Rinse Syringe Flow
1
2
3
4
5
6
7
8
9
10
11
12
Directing:
-WBC/BASO bath
-Probe circuit
Hgb Lyse
Rinse
Fix
Diluent
WBC Lyse
Reagent syringes
Rinse
DIL 1
Hgb
DIFF
RBC
WBC
BASO
Rinse
Fix
Hgb Lyse
WBC Lyse
WBC/BASO Rinse reagent circuit
7616019A

Diluter System

Diluent Input (Figure 2.8-10)

Diluent for the A^{C}•T 5diff hemtology analyzer enters a fitting at the rear of the instrument from a diluent container and is stored in the diluent reservoir. The input tubing from the diluent container should be no longer than 2 meters (78.7 in.) and the top of the container cannot be lower than 80 cm (31.5 in.) from the input fitting on the instrument. Vacuum, produced by the count syringe, is used to draw diluent into the diluent reservoir from the diluent container. This vacuum is applied to port 2 of the diluent reservoir. Solenoid valve 15, Diluent Reservoir Vent, is activated to connect the diluent reservoir to the count syringe. When in the normal inactive state, this valve vents the diluent reservoir to atmosphere. The vent tubing from port 1 of valve 15 is notched to ensure it does not seal against any surface and is routed to the left side drip tray. A float sensor located in the reservoir is used to determine when the reservoir is full, or needs more diluent.

Figure 2.8-10 Diluent Reagent Circuit


ISOLATOR
Internal/External Sleeving
Control Entry/Exit syringe
Diluent Syringe Flow
T2
T3
1
2
3
4
5
6
7
8
9
10
11
See Probe Diluent reagent circuit
See Bath Diluent reagent circuit
Directing flow cell /DIFF bath
12
13
14
15
16
AIR
AIR
COUNT SYRINGE
Vents Diluent reservoir to atmosphere
5diff Syringe
Hgb lyse
Rinse
Fix
Diluent
WBC lyse
Reagent Syringes
20
21
22
23
24
25
26
Diluent reservoir
Entry of Diluent
DILUENT
WASTE
Diluent reagent circuit

7616022A

Two ports distribute diluent from the diluent reservoir. Port 1 supplies diluent to be used by the flow cell while port 3 supplies diluent for the baths and aspirate probe. Solenoid valve 3 normally connects port 1 of the diluent reservoir to the center syringe piston in the 5diff syringe assembly, allowing the syringe to fill with diluent. For diluent output from the 5diff syringe see 5diff Syringe and Flow Cell.

Solenoid valve 9 connects the diluent reagent syringe to port 3 of the diluent reservoir, and when it is in a normal inactive state, this path is open, allowing the syringe to be filled. For output from the main diluent syringe, see Diluent to Baths and Probe and Probe Rinse.

5diff Syringe and Flow Cell

Diluent for several flow cell requirements originates at the center syringe piston of the 5diff syringe assembly. When solenoid valve 3 is active, valves 1 and 2 have control of the diluent path. If valve 2 is energized, diluent is sent from the large center syringe piston to (and through) the left injector piston. A short upward stroke is used to fill the small left injector piston with clean diluent. Since the center syringe piston is much larger, even a short stroke will produce excess diluent, which exits out the top of the left injector piston and through the flow cell.

When valve 2 is in the normal state, valve 1 determines where diluent is routed. An energized valve 1 allows diluent to be sent through the heater assembly to port 2 of the DIFF bath. This is used for the second part of the DIFF dilution when 1 mL of diluent is added to the sample 12 seconds after the original dilution with Fix. This stops the staining action of the Fix.

Solenoid valve 1 in its normal inactive state creates a diluent path for the flow cell outer sheath. During normal flow cell operation, the center syringe piston (solenoid valve 3 energized and solenoid valves 1 and 2 in a normal inactive state) sends diluent through an electrical isolator and T-fitting to ports 2 and 4 of the flow cell. This creates an outer sheath or fluid pipe around the stream of fluid exiting the flow cell aperture. This sheath is approximately 140 µm in diameter.

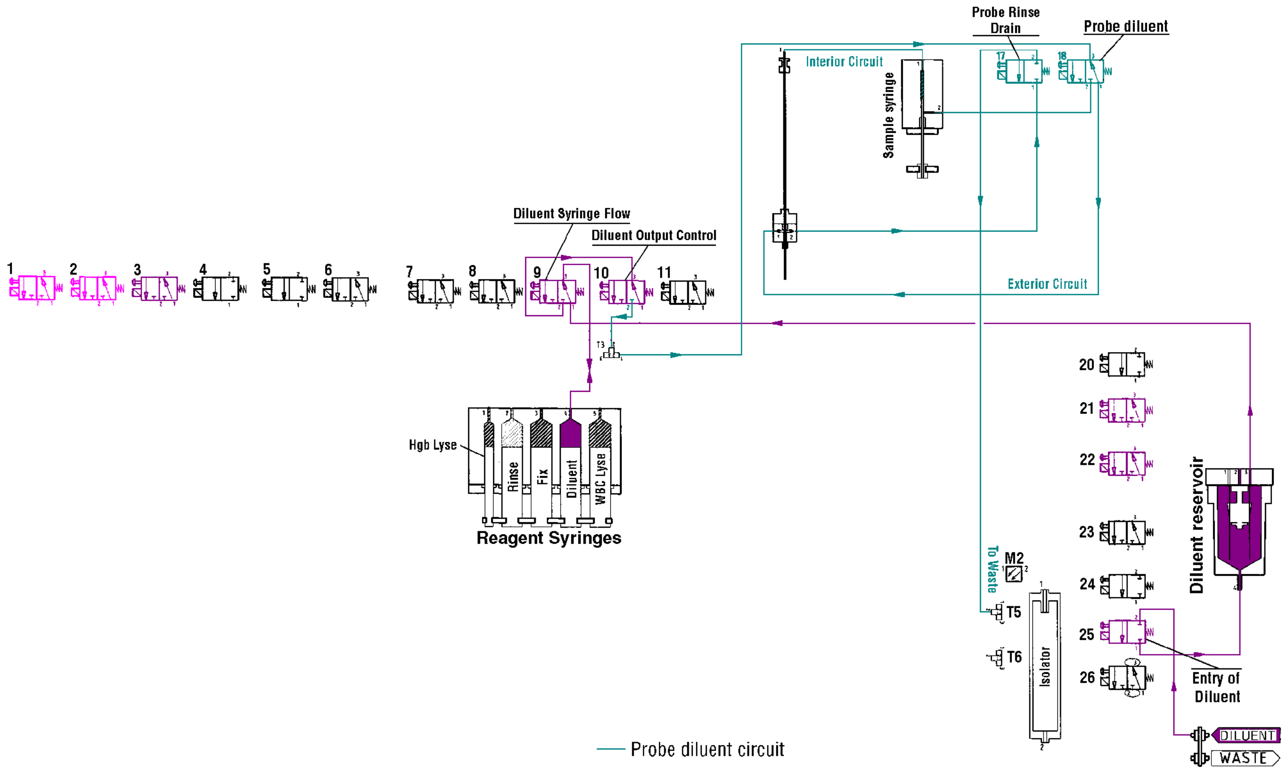
During the upward stroke of normal flow cell operation, the 5diff syringe assembly creates the inner sheath flow. Diluent exits from the top of the left injector piston and enters the flow cell at port 5. It then forms the inner sheath, creating a fluid pipe around the injected sample. The sample injector creates sample flow of 40 µm in diameter, while the sample and inner sheath is forced through the aperture, which is 60 µm in diameter. On exiting the aperture, an outer sheath is created and this double sheath around the sample is called Dual Focused Flow, or DFF.

Sample is sent through the flow cell with the right injector piston (see Figure 2.8-13), but it first must be positioned. The sample dilution, created in the DIFF bath, is drained with the waste syringe. The vacuum path to the waste syringe, starting at the bath, is through fluid sensor M1, an energized solenoid valve 4, through the right injector piston (note that the piston is not being used at this time), through an energized solenoid valve 5, T-fitting T6, waste fluid sensor M2, a fluidic/electrical isolator, and solenoid valve 26 in its normal inactive state. Fluid is drained from the bath until sensor M1 detects air. The length and size of the tubing ensures that the sample does not actually reach or enter the right injector piston when sensor M1 detects air and stops flow. This is critical. When the injector piston pushes up, sample in the tubing between T-fitting T2 and port 5 of the right injector piston is sent through the flow cell.

Probe and Probe Rinse

When valves 9 and 10 are both energized (Figure 2.8-11), diluent output from the diluent syringe is sent to the probe and probe rinse block by way of solenoid valve 18. An energized solenoid 18 routes diluent through the sample syringe and out the probe for backwash and sometimes dilution. Note that the sample syringe is not used at this time. Since the piston seal is an O-ring at the base of the piston, rather than a seal at the top of the piston, the bottom fitting and top fitting on the syringe assembly have an open fluid path. Diluent is sent through an inactive sample syringe by the diluent syringe. The sample syringe is only used when aspirating or dispensing sample.

Figure 2.8-11 Probe Diluent Reagent Circuit


Probe Rinse Drain
Probe diluent
Interior Circuit
Sample syringe
17
18
Diluent Syringe Flow
Diluent Output Control
1
2
3
4
5
6
7
8
9
10
11
Exterior Circuit
T3
20
21
22
23
24
25
26
Hgb Lyse
Rinse
Fix
Diluent
WBC Lyse
Reagent Syringes
Diluent reservoir
To Waste
M2
T5
T6
Isolator
Entry of Diluent
DILUENT
WASTE
Probe diluent circuit

7616020A

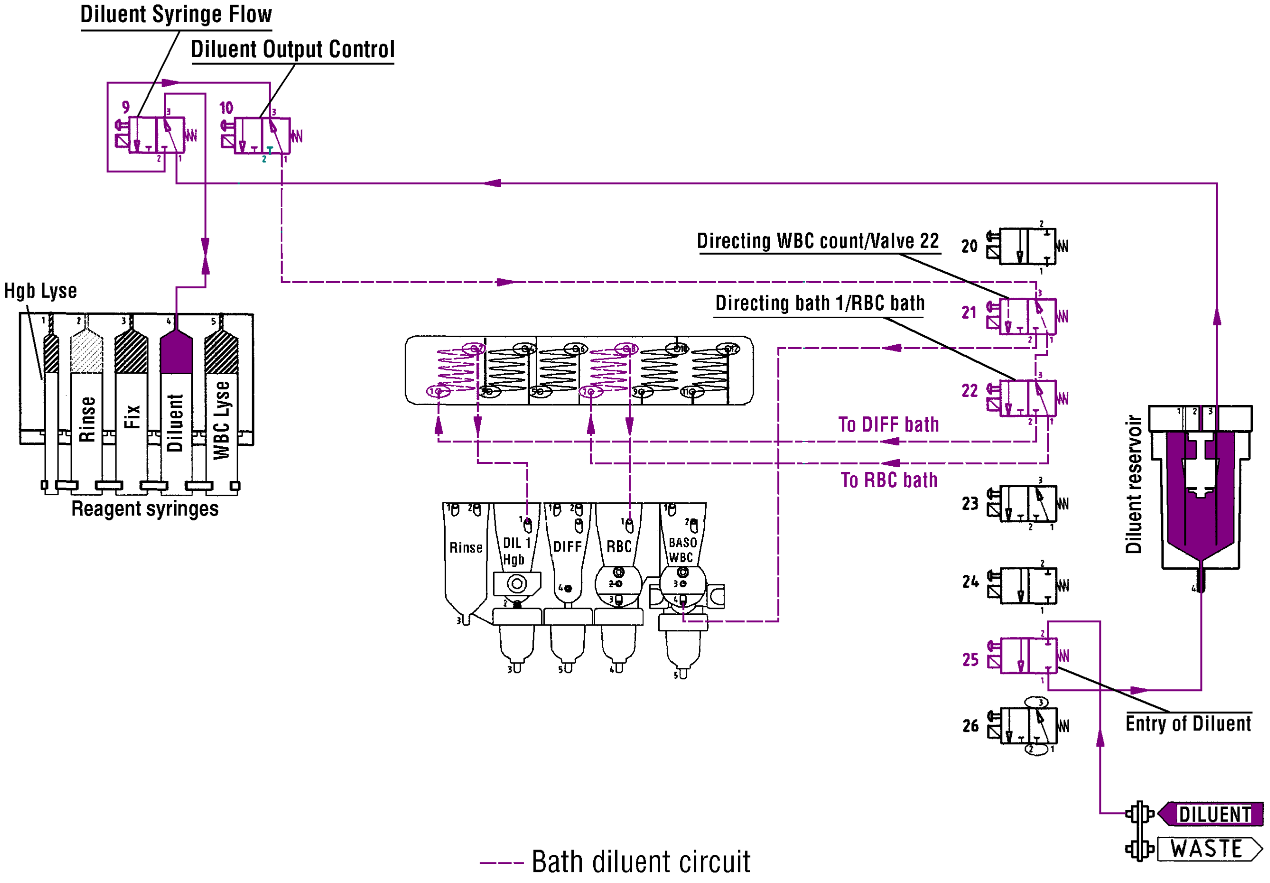
With solenoid valve 18 in its normal inactive state, the diluent is sent to fitting 1 on the probe rinse block. This fluid exits the rinse block from fitting 2 and passes through solenoid valve 17 to the waste system. Usually, this occurs while the probe is moving up through the rinse block to clean blood off the exterior of the probe. However, this is not always the case. On occasion, solenoid 17 is not opened, and the probe does not move. Diluent is forced to flow down the outside of the probe. This is done once to clean the exterior of the probe without moving it and another time to add a small amount of diluent to a dilution.

Diluent to Baths

Energizing solenoid valve 9 routes the diluent syringe output through solenoid valve 10 (Figure 2.8-12). In the normal state of valve 10, diluent is routed for use at the sample baths. There are 3 uses of diluent at the baths, diluent for dilution in the Hgb bath, diluent for dilution in the RBC bath, and rinse for the WBC/BASO counting head.

Solenoid valve 21 routes diluent for dilutions through valve 22 when in a normal inactive state. Valve 22 selects the RBC bath (normal, inactive state) or the Hgb bath (energized state). The fluid paths to the baths both go through a heater block. Each path has a 1 mL coil of fluid in the heater block which allows 1 mL of reagent to be heated to 35°C prior to being delivered to the bath.

Figure 2.8-12 Bath Diluent Reagent Circuit


Diluent Syringe Flow
Diluent Output Control
9
10
Hgb Lyse
Rinse
Fix
Diluent
WBC Lyse
Reagent syringes
Directing WBC count/Valve 22
20
21
Directing bath 1/RBC bath
22
To DIFF bath
To RBC bath
23
24
25
26
Diluent reservoir
Entry of Diluent
DILUENT
WASTE
Rinse
DIL 1 Hgb
DIFF
RBC
BASO WBC
--- Bath diluent circuit

7616021A

When solenoid valve 21 is energized, fluid is sent to the WBC/BASO counting head to rinse the pathway and counting head. This is necessary since fluid in this area is used to flush cells from the rear of the RBC/Plt aperture, a technique called the Rinse Flow System (RFS). During the RBC/Plt count, the WBC/BASO count head is connected to the RBC/Plt count head through an inactive (normal state) valve 23. The vacuum applied to the RBC/Plt aperture actually draws fluid (rinse solution, not diluent) from the WBC/BASO bath, through the WBC/BASO aperture, and past the rear of the RBC/Plt aperture, sweeping away any RBC cells from the rear of the aperture. When solenoid valve 23 is energized, the WBC/BASO counting head is connected directly to the counting syringe, providing vacuum for the WBC/BASO count.

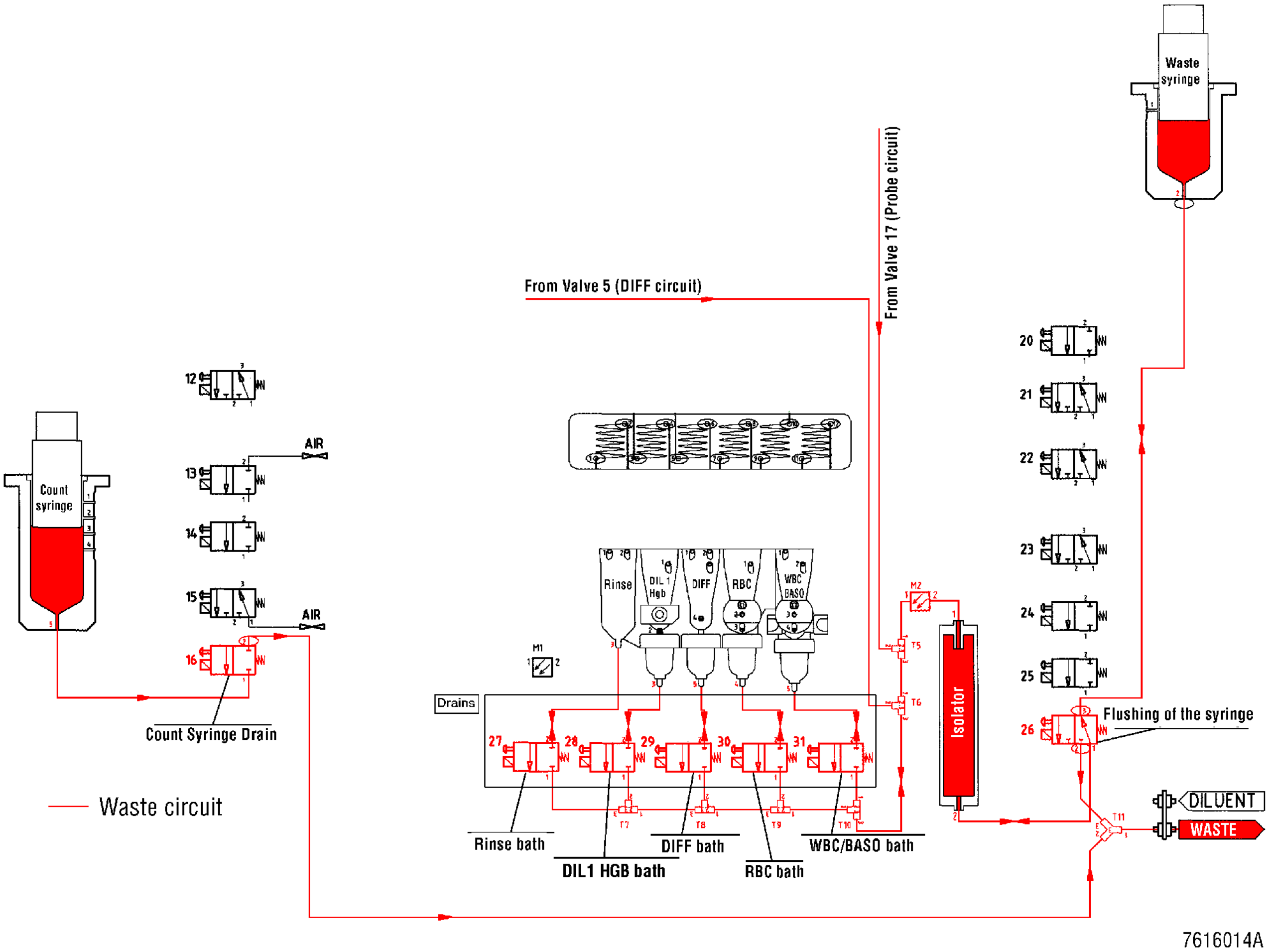
Waste System

The waste and drain system (Figure 2.8-13) comprises many components. The waste syringe itself is used to drain the baths, and to expel waste from the baths. The count syringe expels any waste that it accumulates during count directly into the waste system through normally closed solenoid valve 16. Waste from the probe rinse block is pushed out by the diluent syringe as well as being evacuated with the waste syringe.

The bath drain system connects each bath, including the rinse chamber, through a normally closed solenoid valve to the waste system with a series of T-fittings. There is a fluid isolator chamber between the baths and the waste syringe and container. This electrically isolates the baths (and flow cell and aspirate probe) from any interference that can be picked up by the external waste system. Draining waste from any bath involves opening the associated solenoid valve while the drain syringe is filling. Solenoid valve 26 is then energized, which connects the waste syringe to the external waste system, and waste is expelled.

There is also a fluid sensor, M2, in the waste system, just before the isolator. It is used to detect whether the waste system has fluid or air at the appropriate times. It is not used to stop a drain action, like M1 does when detecting that sample has been drained from the DIFF bath.

Figure 2.8-13 Waste Circuit


Waste syringe
From Valve 17 (Probe circuit)
From Valve 5 (DIFF circuit)
20
21
22
23
24
25
26
Flushing of the syringe
12
13
14
15
16
AIR
AIR
Count syringe
Count Syringe Drain
Waste circuit
Rinse
DIL 1 Hgb
DIFF
RBC
WBC BASO
M1
M2
T5
T6
T7
T8
T9
T10
T11
Isolator
Drains
27
28
29
30
31
Rinse bath
DIL1 HGB bath
DIFF bath
RBC bath
WBC/BASO bath
DILUENT
WASTE
7616014A

2.9 ELECTRONIC SYSTEM

Plug/Jack Labels

In some circumstances, connectors may not have matching plug/jack (P/J) labels. For example, cable connector J5 plugs into board connector J5 on the traverse interconnect card.

Optical Preamplifier Card

This card:

- Performs an absorbance measurement.
- Is a voltage amplifier.
- Contains a photodiode that measures absorbance of light through the cell. The Optical Preamplifier card returns an intensity proportional to the light signal. (The light signal is proportional to the cell size, complexity and staining.)

LCD and Keypad Card

This card includes the keypad and LCD screen is connected to the Main card using one flat cable through connector J1. The LED card is connected to this card through connector J4.

LED Card

This card supports the LEDs that are used to quickly identify instrument status. These LEDs are located on the front panel.

- A red glowing LED indicates the instrument is busy.
- A green glowing LED indicates the instrument is ready for operation.

Motor Interconnect Card

All the different motors and end-of-run sensors are connected to this card. The Motor Interconnect card is connected to the Main card using one flat cable through connector J2.

Traverse Interconnect Card

All the Traverse module electrical functions are connected to this card. The Traverse Interconnect card is connected to the Main card using one flat cable through connector J5.

2.10 SOFTWARE STRUCTURE

Overview

The operating system software provides instrument I/O, system error checks, data analysis, and individual diluter subroutines or functions. The operating system software also provides diluter functions that energize solenoids, drive motors, and check sensors in the diluter.

Menu Trees

Most I/O functions of the operating system software are controlled by the user. This interaction between the user and the instrument is called the user interface. A pushbutton keypad and an LCD screen provide the physical user interface, while menu items provide the software user interface. These menu items have associated arabic numerals.

The Main Menu consists of five options:

1. RUN SAMPLES

2. CALIBRATION

3. REAGENTS

4. DIAGNOSTICS

5. SETUP

How to Select a Menu Item

An operator may select a menu item two different ways,

1. Use the ↑ or ↓ arrow keys to highlight the desired menu item then press ↵ (**ENTER** pushbutton on the instrument keypad) to select the highlighted option.

   or

2. Simply press the numeric pushbutton (on the instrument keypad) that correlates with the desired option. This is the faster way to select a menu item.

For example, to select the **3. REAGENTS** menu item from the Main Menu, an operator may:

- Use the down arrow ↓ to highlight **3. REAGENTS** then press **ENTER** ↵.

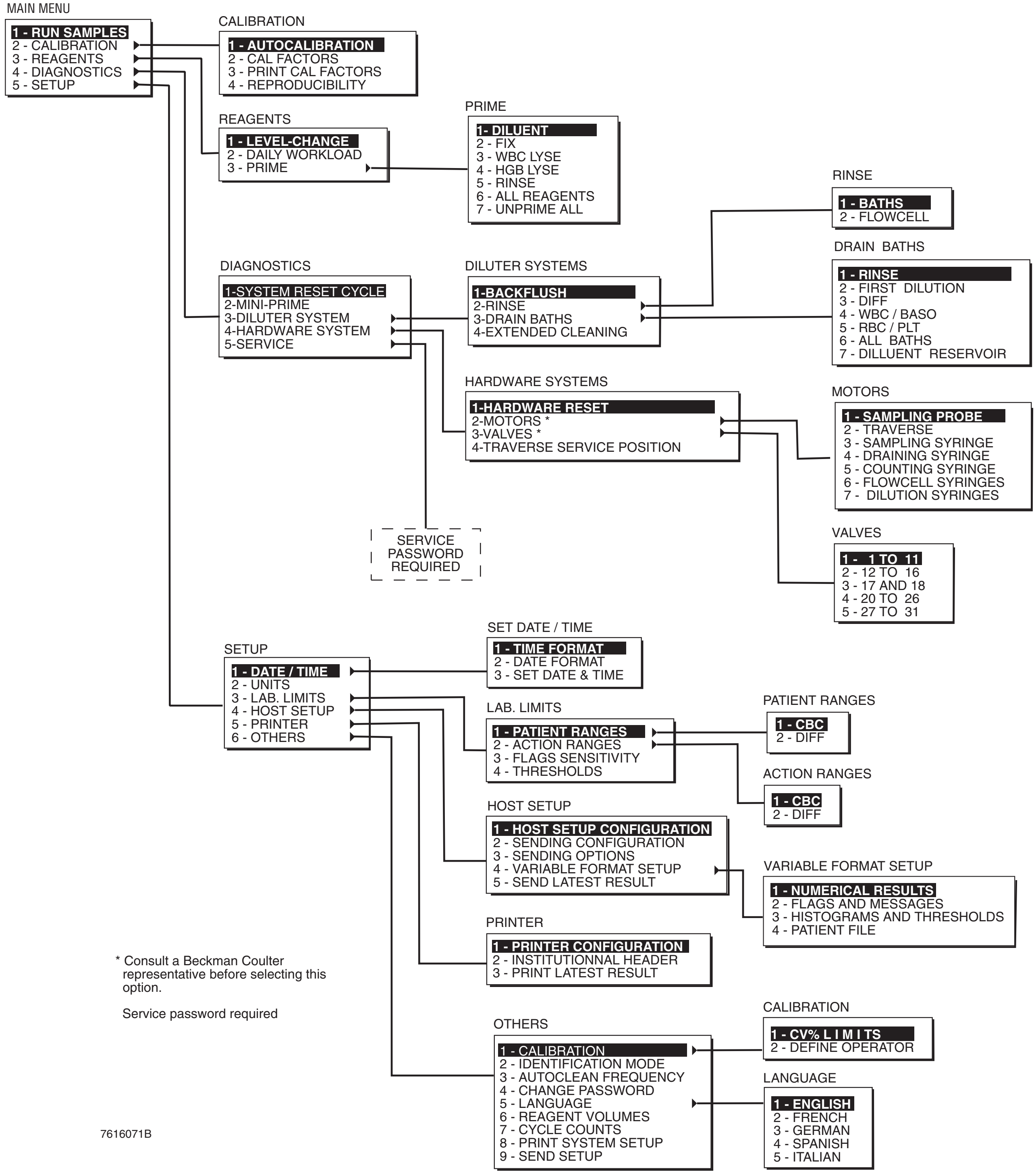
  or

- Press the pushbutton labeled **3** on the instrument keypad.

With the exception of Main Menu item **1. RUN SAMPLES**, selecting a menu option produces a submenu with a listing of additional options that may be selected.

See Figure 2.10-1 and Figure 2.10-2 for a graphic representation of the menus and menu items (or options) available for the user and service personnel.

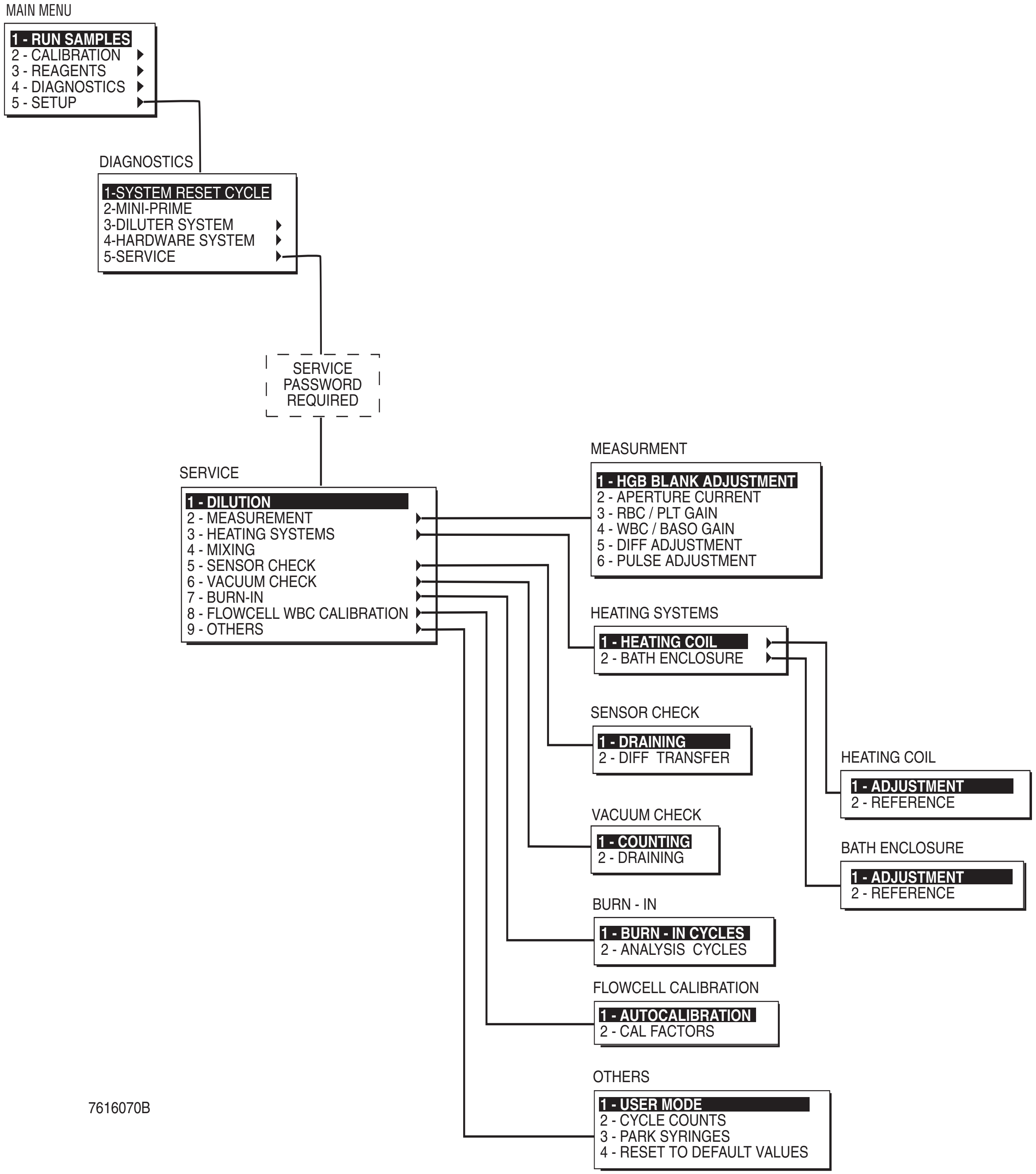
Figure 2.10-1 User Menu Tree


MAIN MENU
1 - RUN SAMPLES
2 - CALIBRATION
3 - REAGENTS
4 - DIAGNOSTICS
5 - SETUP
CALIBRATION
1 - AUTOCALIBRATION
2 - CAL FACTORS
3 - PRINT CAL FACTORS
4 - REPRODUCIBILITY
REAGENTS
1 - LEVEL-CHANGE
2 - DAILY WORKLOAD
3 - PRIME
PRIME
1- DILUENT
2 - FIX
3 - WBC LYSE
4 - HGB LYSE
5 - RINSE
6 - ALL REAGENTS
7 - UNPRIME ALL
RINSE
1 - BATHS
2 - FLOWCELL
DIAGNOSTICS
1-SYSTEM RESET CYCLE
2-MINI-PRIME
3-DILUTER SYSTEM
4-HARDWARE SYSTEM
5-SERVICE
DILUTER SYSTEMS
1-BACKFLUSH
2-RINSE
3-DRAIN BATHS
4-EXTENDED CLEANING
DRAIN BATHS
1 - RINSE
2 - FIRST DILUTION
3 - DIFF
4 - WBC / BASO
5 - RBC / PLT
6 - ALL BATHS
7 - DILLUENT RESERVOIR
HARDWARE SYSTEMS
1-HARDWARE RESET
2-MOTORS *
3-VALVES *
4-TRAVERSE SERVICE POSITION
MOTORS
1 - SAMPLING PROBE
2 - TRAVERSE
3 - SAMPLING SYRINGE
4 - DRAINING SYRINGE
5 - COUNTING SYRINGE
6 - FLOWCELL SYRINGES
7 - DILUTION SYRINGES
SERVICE PASSWORD REQUIRED
VALVES
1 - 1 TO 11
2 - 12 TO 16
3 - 17 AND 18
4 - 20 TO 26
5 - 27 TO 31
SET DATE / TIME
1 - TIME FORMAT
2 - DATE FORMAT
3 - SET DATE & TIME
SETUP
1 - DATE / TIME
2 - UNITS
3 - LAB. LIMITS
4 - HOST SETUP
5 - PRINTER
6 - OTHERS
LAB. LIMITS
1 - PATIENT RANGES
2 - ACTION RANGES
3 - FLAGS SENSITIVITY
4 - THRESHOLDS
PATIENT RANGES
1 - CBC
2 - DIFF
ACTION RANGES
1 - CBC
2 - DIFF
HOST SETUP
1 - HOST SETUP CONFIGURATION
2 - SENDING CONFIGURATION
3 - SENDING OPTIONS
4 - VARIABLE FORMAT SETUP
5 - SEND LATEST RESULT
VARIABLE FORMAT SETUP
1 - NUMERICAL RESULTS
2 - FLAGS AND MESSAGES
3 - HISTOGRAMS AND THRESHOLDS
4 - PATIENT FILE
PRINTER
1 - PRINTER CONFIGURATION
2 - INSTITUTIONNAL HEADER
3 - PRINT LATEST RESULT
OTHERS
1 - CALIBRATION
2 - IDENTIFICATION MODE
3 - AUTOCLEAN FREQUENCY
4 - CHANGE PASSWORD
5 - LANGUAGE
6 - REAGENT VOLUMES
7 - CYCLE COUNTS
8 - PRINT SYSTEM SETUP
9 - SEND SETUP
CALIBRATION
1 - CV% L I M I TS
2 - DEFINE OPERATOR
LANGUAGE
1 - ENGLISH
2 - FRENCH
3 - GERMAN
4 - SPANISH
5 - ITALIAN
7616071B

* Consult a Beckman Coulter representative before selecting this option.

Service password required

Figure 2.10-2 Service Menu Tree


MAIN MENU
1 - RUN SAMPLES
2 - CALIBRATION
3 - REAGENTS
4 - DIAGNOSTICS
5 - SETUP
DIAGNOSTICS
1-SYSTEM RESET CYCLE
2-MINI-PRIME
3-DILUTER SYSTEM
4-HARDWARE SYSTEM
5-SERVICE
SERVICE
PASSWORD
REQUIRED
SERVICE
1 - DILUTION
2 - MEASUREMENT
3 - HEATING SYSTEMS
4 - MIXING
5 - SENSOR CHECK
6 - VACUUM CHECK
7 - BURN-IN
8 - FLOWCELL WBC CALIBRATION
9 - OTHERS
MEASURMENT
1 - HGB BLANK ADJUSTMENT
2 - APERTURE CURRENT
3 - RBC / PLT GAIN
4 - WBC / BASO GAIN
5 - DIFF ADJUSTMENT
6 - PULSE ADJUSTMENT
HEATING SYSTEMS
1 - HEATING COIL
2 - BATH ENCLOSURE
SENSOR CHECK
1 - DRAINING
2 - DIFF TRANSFER
HEATING COIL
1 - ADJUSTMENT
2 - REFERENCE
VACUUM CHECK
1 - COUNTING
2 - DRAINING
BATH ENCLOSURE
1 - ADJUSTMENT
2 - REFERENCE
BURN - IN
1 - BURN - IN CYCLES
2 - ANALYSIS CYCLES
FLOWCELL CALIBRATION
1 - AUTOCALIBRATION
2 - CAL FACTORS
OTHERS
1 - USER MODE
2 - CYCLE COUNTS
3 - PARK SYRINGES
4 - RESET TO DEFAULT VALUES
7616070B

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3.1 PREINSTALLATION CHECKS

Prior to installing the A^{C}•T 5diff hematology analyzer, a pre-site inspection is required to verify the following conditions:

Environment

The A^{C}•T 5diff analyzer should be operated in an indoor location only.

Altitude Range

The A^{C}•T 5diff hematology analyzer may be operated at any altitude up to 3,000 meters (9,843 feet). Operation at an altitude over 3,000 meters (9,843 feet) is not recommended.

Ambient Temperature

The ambient operating temperature is 16 to 34°C (61 to 93°F). If the A^{C}•T 5diff analyzer is kept at a temperature less than 10°C (50°F), the instrument should be allowed to set at a proper room temperature for one hour before use.

Space and Accessibility Requirements

The A^{C}•T 5diff hematology analyzer should be placed on a clean and level table or work station. Please note that the instrument, printer, and reagents weigh approximately 37 kg (81 lbs).

WARNING Risk of operator injury if only one person lifts the instrument. The instrument weighs more than 18 Kg (40 lbs.) and has no lifting handles. To prevent injury, at least two people following necessary safety precautions should lift the instrument together.

The diluent container may be placed on the same level as the instrument or below. If placed on the floor, the top of the diluent container cannot be lower than 80 cm (31.5 inches) from the table level of the instrument. The diluent and waste tubings are limited in length to a maximum of 2 meters (78 inches).

Check the site for proper space allocation (Table 3.1-1).

Table 3.1-1 Space Requirements

Linear Dimensions	Required by Instrument
Height	58.0 cm (23.0 inches)
Width	44.4 cm (17.5 inches)
Depth	50.1 cm (19.8 inches) plus an additional 20.0 cm (8.0 inches) for proper ventilation

Electrical Input

IMPORTANT Risk of erroneous results. If an extension cord is used, electrical interference could affect the instrument's operation and results. Locate the instrument close enough to a power outlet that an extension cord is not necessary.

Check for the availability of a power connector. Make sure the instrument is close enough to a power outlet that the ac power cable safely reaches it. The ac power cable is 1.8 meters (6 feet) long and is attached to the back of the instrument, in the lower right corner.

Power Requirements

Verify the wall socket is an outlet capable of supplying 100 Vac to 240 Vac, from 50 Hz to 60 Hz.

Grounding

Proper grounding is required. Verify the ground (earth) for the wall plug is correctly connected to the laboratory grounding electricity installation. If there is no ground, use a ground stake. Current electricity standards must be applied.

Installation Category

This instrument is designed to be safe for transient voltages according to Installation Category II and Pollution Degree 2.

Electromagnetic Environment Check

The A^{C}•T 5diff analyzer produces less than the acceptable level of electromagnetic interference when properly placed. Electromagnetic interferences are limited to levels that allow the correct operation of other instruments conforming to their placement.

To avoid problems, make sure the instrument is not placed near electromagnetic fields or shortwave emissions (such as radar, X-ray machines, scanners, and so forth).

Inspection Report

Review the findings with your contact person. If deficiencies are present, make sure the customer understands what actions are necessary to meet the specifications for the system. Establish a time frame for completion. Notify your manager if the installation must be rescheduled.

3.2 INITIAL SETUP

Preinstallation Checks

If any deficiencies were noted during the preinstallation check, verify they are resolved before installing the instrument.

Supplies

Make sure an adequate supply of reagents, controls, and calibrator are available at the site. For details, see Chapter 1 of the Operator's Guide.

Unpacking

Inspection

Inspect all boxes for damage. Notify shipping of external damage.

Unpack the Analyzer

1. Unpack the analyzer and place it on the table or bench as determined in the preinstallation site inspection.
2. Check the instrument for damage.

Unpack the Installation Kit, PN XEA484A

1. Unpack the Installation kit.
2. Using the parts list in Table 8.1-8, ensure that no parts are missing.

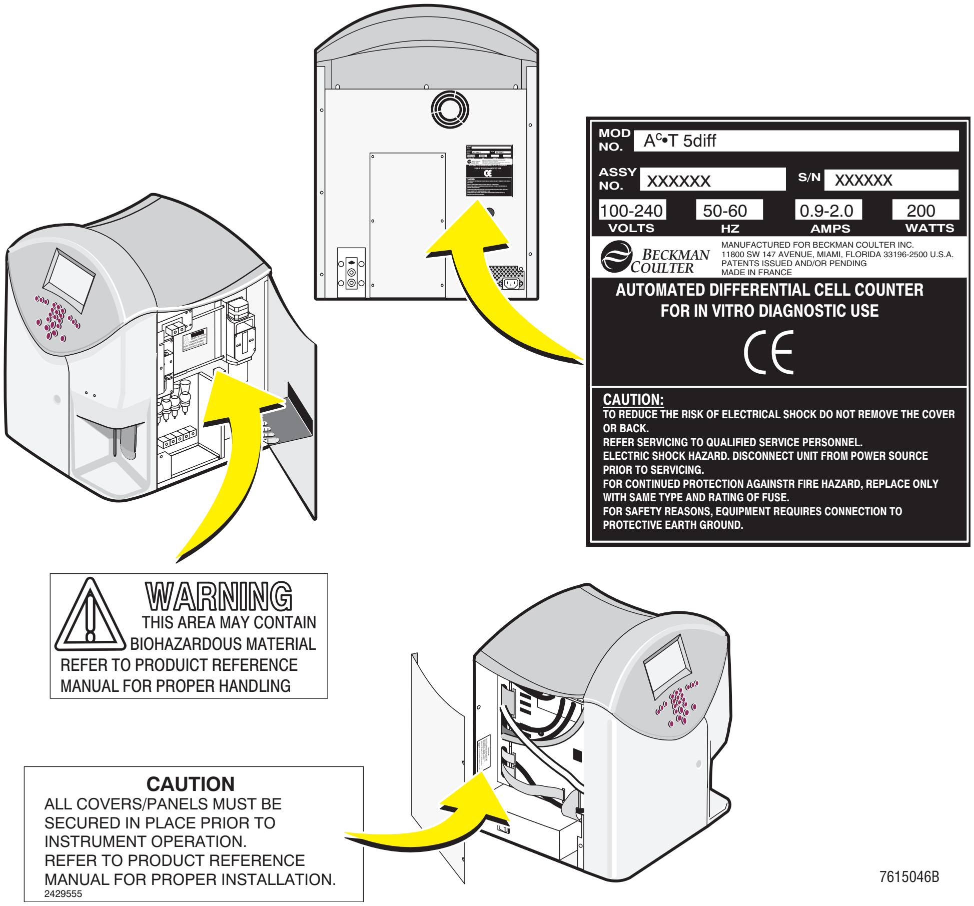
Unpack the Waste Alarm Kit, PN 6912680

1. Unpack the Waste Alarm kit.
2. Using the packing slip, ensure that no parts are missing.
3. Make sure the additional parts needed to complete the installation are available:
   - Two sets of Velcro strips, precut (2" x 1")
     - Hook strip, PN 1017414 (need 2)
     - Loop strip, PN 1017413 (need 2)
   - Tubing, 035 clear polyurethane, 2-inch piece, PN 3202035
   - Feed-through fitting, PN 6216308

Verify All Caution and Compliance Labels are in Place

1. Verify the caution label on the back of the instrument is in place (Figure 3.2-1).

Figure 3.2-1 Warning and Caution Label Locations on the Instrument



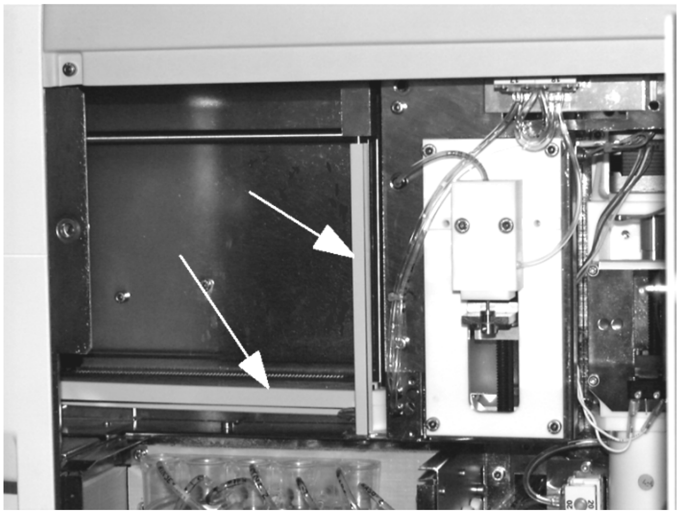
MOD NO. A^{c}•T 5diff
ASSY NO. XXXXXX
S/N XXXXXX
100-240 VOLTS
50-60 HZ
0.9-2.0 AMPS
200 WATTS
BECKMAN COULTER
MANUFACTURED FOR BECKMAN COULTER INC.
11800 SW 147 AVENUE, MIAMI, FLORIDA 33196-2500 U.S.A.
PATENTS ISSUED AND/OR PENDING
MADE IN FRANCE
AUTOMATED DIFFERENTIAL CELL COUNTER
FOR IN VITRO DIAGNOSTIC USE
CE
CAUTION:
TO REDUCE THE RISK OF ELECTRICAL SHOCK DO NOT REMOVE THE COVER OR BACK.
REFER SERVICING TO QUALIFIED SERVICE PERSONNEL.
ELECTRIC SHOCK HAZARD. DISCONNECT UNIT FROM POWER SOURCE PRIOR TO SERVICING.
FOR CONTINUED PROTECTION AGAINSTR FIRE HAZARD, REPLACE ONLY WITH SAME TYPE AND RATING OF FUSE.
FOR SAFETY REASONS, EQUIPMENT REQUIRES CONNECTION TO PROTECTIVE EARTH GROUND.

WARNING
THIS AREA MAY CONTAIN
BIOHAZARDOUS MATERIAL
REFER TO PRODUICT REFERENCE
MANUAL FOR PROPER HANDLING

CAUTION
ALL COVERS/PANELS MUST BE
SECURED IN PLACE PRIOR TO
INSTRUMENT OPERATION.
REFER TO PRODUCT REFERENCE
MANUAL FOR PROPER INSTALLATION.
2429555

2. Open the right side door. This door is fastened with two partial-turn, captive-slotted screws.
3. Remove the two plastic blockers from the traverse assembly, one from the horizontal and a second from the vertical traverse guide rod. See Figure 3.2-2.

Figure 3.2-2 Plastic Blocker Locations, View with Right Door Open



4. Manually push the sample probe assembly towards the front of the instrument and verify the warning label is in place (Figure 3.2-1).
5. Remove the four hex screws securing the left side panel to the instrument frame and verify the caution label is in place (Figure 3.2-1).
6. Replace the left side panel.

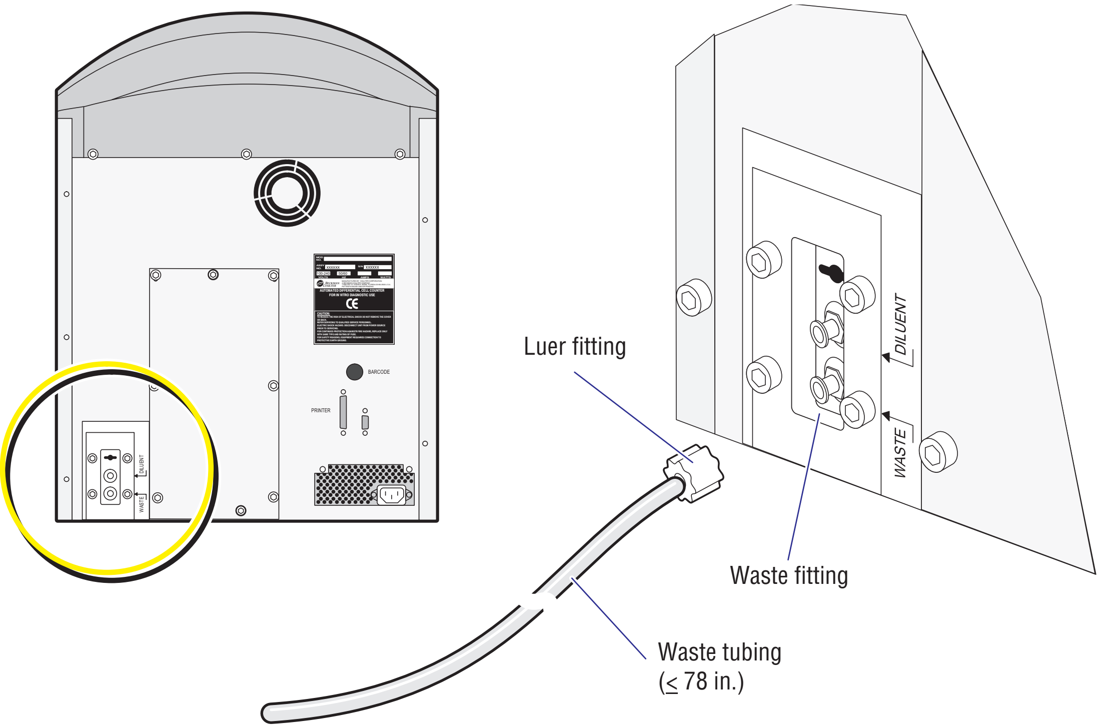
Connect the Waste System

Connect the Waste Tubing

ATTENTION: The waste tubing is limited in length to a maximum of 2 meters (78 inches).

1. Attach one end of waste tubing (4x6 mm / PN - EAE028A) to Luer fitting (PN - EAC019A).
2. Connect the Luer fitting to the lower waste fitting on the back of the instrument (Figure 3.2-3).

Figure 3.2-3 Rear Panel Connections

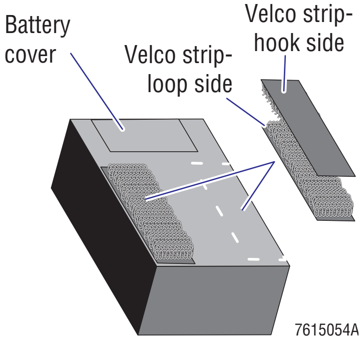


Install the Waste Alarm

If a 20 L container is used for waste, connect the waste alarm as follows:

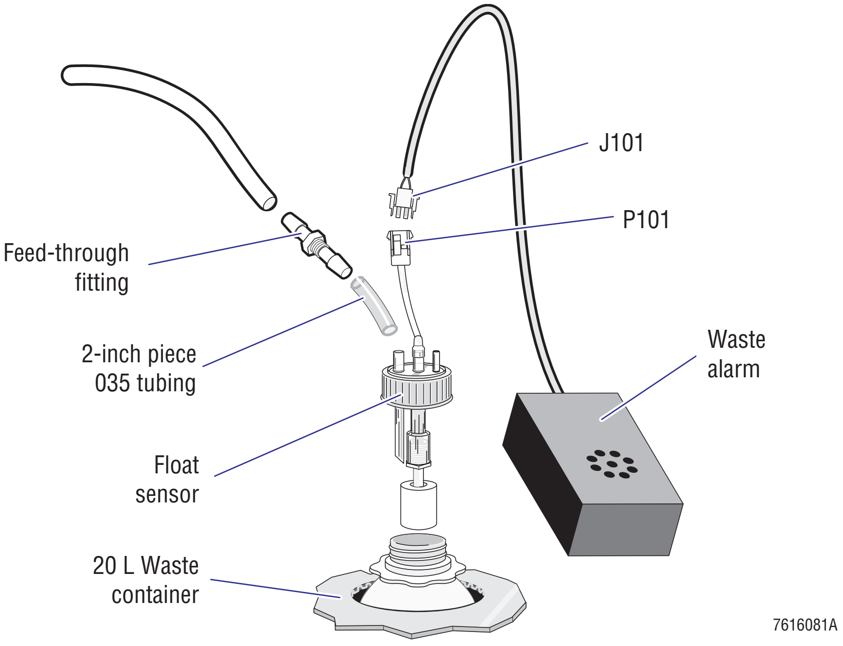
1. Remove the battery cover and install the battery in the alarm casing. Replace the cover.
2. One at a time, remove the adhesive backing from a loop velcro strip and attach it to the back of alarm casing. The placement must be opposite the battery cover, in the left and right corners (Figure 3.2-4).

Figure 3.2-4 Loop-Side Velcro Strip Attachment


Battery cover
Velco strip- loop side
Velco strip- hook side
7615054A

3. Without removing the adhesive backing, attach the hook fastener of the velcro strips to the loop strips.
4. Plug the float sensor connector P101 into the alarm connector J101.
5. Invert the float to activate a loud, repetitive beep.
   - If the alarm is working properly, separate the connectors.
   - If a low chirp sound occurs instead, the battery is low. Replace the battery.
6. Install the 2-inch piece of 035 tubing (Figure 3.2-5) on the large feed-through fitting (threaded side). Firmly seat.

Figure 3.2-5 Waste Alarm and Float Sensor Setup

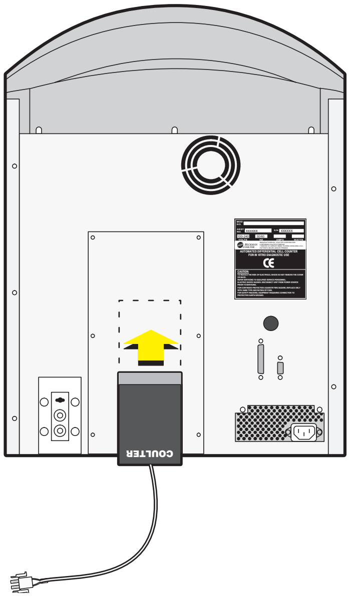

J101
P101
Feed-through fitting
2-inch piece 035 tubing
Float sensor
Waste alarm
20 L Waste container
7616081A

7. Install the other end of tubing on the top of float sensor port. Firmly seat.
8. Insert the other end of fitting (unthreaded side) into waste tubing.

   Note: Make sure that tubing is installed over both barbs.
9. Place the float sensor in a 20-liter waste container. Screw the cap on tightly.

10. Install the waste alarm on the back of the instrument as follows:
    a. While holding the alarm casing with its connector hanging freely downward, remove the adhesive backing from the hook side of the velcro strips.
    b. Attach the alarm to the rear access panel (Figure 3.2-6).

Figure 3.2-6 Position the Waste Alarm on the Rear Access Panel



11. Plug the float sensor connector P101 into the alarm connector J101.

Connect the Reagents

IMPORTANT Risk of misleading results. If a reagent pickup tube is contaminated, bacterial and/or fungal growth may occur inside the reagent container. This growth may cause unacceptable background results especially for Plts. When connecting the reagent pickup tubes, the straw portion of the pickup tube should not be touched or laid on an uncovered tabletop. Ensure the reagent pickup tubes remain clean and free of contamination.

Connect the Diluent Tubing

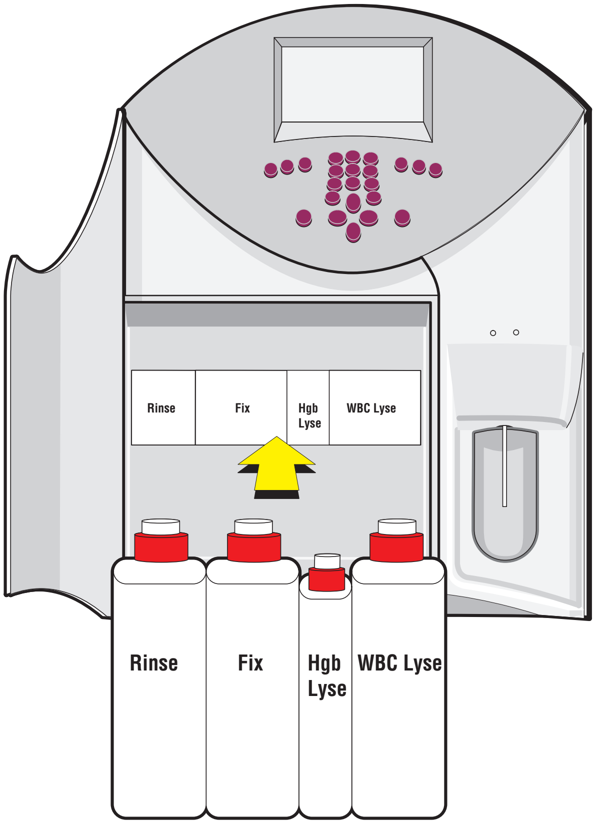
ATTENTION: The diluent tubing is limited in length to a maximum of 2 meters (78 inches). The diluent container may be placed on the same level as the instrument or below. If placed on the floor, the top of the diluent container cannot be lower than 80 cm (31.5 inches) from the table level of the instrument.

1. Attach one end of diluent tubing (3x6 mm / PN - EAE011A) to Luer fitting (PN - EAC019A) and the other to pickup tube (PN - XEA018A).
2. Connect the Luer fitting end to the upper fitting on the rear panel of the instrument (Figure 3.2-3, item 2).
3. Insert stopper FBL001A into the container and insert the diluent pickup tube through the stopper.

Install the Reagent Bottles

1. Open the reagent compartment door (on the front of the instrument).
    a. Note the color-coded label on the back panel. The color coding on the instrument label correlates with the color coding on reagent labels (Figure 3.2-7).
    b. Note the four tubings hanging inside the compartment. Once a bottle stopper is assembled, the assembly is attached to the tubing hanging in its color-coded area and inserted into the reagent bottle. The bottle is then positioned inside the reagent compartment as shown in Figure 3.2-7.

Figure 3.2-7 Reagent Bottle Locations



2. Install the WBC Lyse reagent bottle (Figure 3.2-7):
    a. Loosen the cap of a new WBC Lyse reagent container (yellow label).
    b. Assemble pickup PN - GBG144A with cap PN - GAK302A.
    c. Connect the stopper assembly to the tubing labeled WBC Lyse hanging inside the reagent compartment.
    d. Without lying the assembly down, remove the cap and ring from the new reagent container and insert the stopper assembly into the WBC Lyse reagent bottle.
    e. Place the reagent bottle inside the compartment. Position it in front of the yellow WBC Lyse portion of the compartment label.

3. Install the Hgb Lyse reagent bottle (Figure 3.2-7):
    a. Loosen the cap of a new Hgb Lyse reagent container (orange label).
    b. Assemble pickup PN - GBG145A with cap PN - GBG155A.
    c. Connect the stopper assembly to the tubing labeled Hgb Lyse hanging inside the reagent compartment.
    d. Without lying the assembly down, remove the cap and ring from the new reagent container and insert the stopper assembly into the Hgb Lyse reagent bottle.
    e. Place the reagent bottle inside the compartment. Position it in front of the orange Hgb Lyse portion of the compartment label.
4. Install the Fix reagent bottle (Figure 3.2-7):
    a. Loosen the cap of a new Fix reagent container (green label).
    b. Assemble pickup PN - GBG144A with cap PN - GAK302A.
    c. Connect the stopper assembly to the tubing labeled Fix hanging inside the reagent compartment.
    d. Without lying the assembly down, remove the cap and ring from the new reagent container and insert the stopper assembly into the Fix reagent bottle.
    e. Place the reagent bottle inside the compartment. Position it in front of the green Fix portion of the compartment label.
5. Install the Rinse reagent bottle (Figure 3.2-7):
    a. Loosen the cap of a new Rinse reagent container (blue label)
    a. Assemble pickup PN - GBG144A with cap PN - GAK302A.
    b. Connect the stopper assembly to the tubing labeled Rinse hanging inside the reagent compartment.
    c. Without lying the assembly down, remove the cap and ring from the new reagent container and insert the stopper assembly into the Rinse reagent bottle.
    d. Place the reagent bottle inside the compartment. Position it in front of the blue Rinse portion of the compartment label.

Install the Printer

If you have not already done so, install the printer using the procedure under Heading 3.3, PRINTER INSTALLATION. Once the printer is installed, return to this procedure to complete the instrument installation and verification.

Power On the Instrument

1. Connect the power cord to the back of the instrument (Figure 3.2-3, item 7).
2. Plug the instrument into the ac power source.
3. Turn the instrument on.

    Note: At the factory, a new instrument is left in the Manual Startup mode so the automatic startup is bypassed when the instrument is powered on.

Enter Reagent Lot Numbers

ATTENTION: A reagent lot number contains 11 alpha/numeric characters consisting of five numeric digits, an alphabet letter, and five more numeric digits. For example, the lot number for Diluent might be 00102D00002.

- The digits in a lot number are entered using the numeric keypad on the front of the instrument.
- The letter is added using the up arrow key. The first time the up arrow key is pressed, the letter A appears on the screen, the next time the up arrow key is pressed, the letter B appears, and so forth. In the example above, the up arrow key needs to be pressed four times to display the letter D.
- Pressing the right arrow key saves the letter and moves the cursor to the next entry position.

1. From the Main Menu, select **3. REAGENTS ▸▸ 1. LEVEL - CHANGE**.
2. Press the down arrow key as many times as necessary to highlight the *CHANGE ALL* bar then press **ENTER**. The lot number prompt appears for the reagent.
3. Enter the reagent lot number using the instrument keypad as follows:
   a. Press the numeric keys that correspond with the first five digits.
   b. Press the up arrow key as many times as necessary to display the required letter.
   c. Press the right arrow key to save the letter and move to the next entry position.
   d. Press the numeric keys that correspond with the last five digits.
   e. Press **ENTER** to continue to the next reagent.
   f. Repeat steps a through e for each reagent. When the last lot number is entered, the instrument automatically initiates a prime reagent routine.
4. When the prime reagent routine is done,
   a. Verify all the reagents levels are near 100%.
   b. Press **ESC** to return to the Reagents menu.

Prime the Instrument

1. From the Reagents menu, select **3. PRIME ▸▸ 6. ALL REAGENTS** to prime the reagents again.

   Note: This second prime is necessary because this an installation. After installation, a reagent line is thoroughly primed and the prime routine done at the end of the lot number change is sufficient.
2. Visually inspect the reagent lines and pumps for air bubbles and repeat the priming if air bubbles are still present.

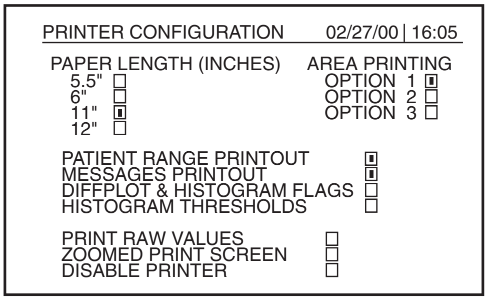
Configure the Instrument Printer Settings

Configure the printer settings, as needed, including.

- Paper length (inches): 5.5 inches, 6 inches, 11 inches, or 12 inches. The paper in the installation kit is 12 inches long.
- Area printing: Options 1 through 3.
- Patient range printout: Prints normal ranges.
- Messages printout: Prints interpretive messages.
- Print Raw Values: Prints raw data. Select this option only for troubleshooting purposes, not for routine operation.
- Zoomed Print Screen: Allows large printout of screen display.
- Disable printer: Does not print the results and does not sound a printer alarm.

1. From the Main Menu, select **SETUP** ▸▸ **PRINTER** ▸▸ **PRINTER CONFIGURATION** (Figure 3.2-8).

Figure 3.2-8 Printer Configuration Menu



```
PRINTER CONFIGURATION        02/27/00 | 16:05

 PAPER LENGTH (INCHES)    AREA PRINTING
    5.5" ☐                   OPTION  1 ▣
    6"   ☐                   OPTION  2 ☐
    11"  ▣                   OPTION  3 ☐
    12"  ☐

  PATIENT RANGE PRINTOUT           ▣
  MESSAGES PRINTOUT                ▣
  DIFFPLOT & HISTOGRAM FLAGS       ☐
  HISTOGRAM THRESHOLDS             ☐

  PRINT RAW VALUES            ☐
  ZOOMED PRINT SCREEN         ☐
  DISABLE PRINTER             ☐
```

2. At the instrument keypad, use the arrow keys to move the blinking cursor into the box next to the desired option.

   Note: If you press the decimal point key too long, the dot may appear then disappear. The dot inside the box indicates the option is selected.

   a. If the box is empty, pressing the decimal point key places a dot inside the box. The dot indicates the option is selected.
   b. If the box has a dot, the option is already selected. Pressing the decimal point key removes the dot which de-selects the option.
3. When all desired selections are made, press **ESC** to save and exit.
4. Press **ESC** as many times as necessary to return to the desired menu.
5. Printer configuration is detailed in Appendix A of the Operator's Guide.

Set the User Mode

At the factory, a new instrument is left in the Manual Startup mode so the automatic startup is bypassed when the instrument is powered on. To make sure the system is primed and operational after the Customer has turned the power off then back on, the Manual Startup mode should be disabled.

Disable the Manual Startup mode as follows:

1. From the Service menu, select **9. OTHERS ▸▸ 1. USER MODE**. The blinking cursor is inside the *MANUAL STARTUP* box. If you look closely, you should also be able to distinguish a dot inside the box.
2. At the instrument keypad, press the decimal point key. Make sure the dot no longer appears inside the *MANUAL STARTUP* box. The automatic startup is reactivated.

   Note: If you press the decimal point too long, the dot may reappear. The dot inside the *MANUAL STARTUP* box indicates the Manual Startup mode is selected.
3. Press **ESC** to save the selection.

IMPORTANT Risk of erroneous Hgb results. The right side door must be closed during Startup. Bypassing the right side door interlock and running the Startup with the right side door open may generate a (• • • •) code for the Hgb blank. Make sure the right side door is closed at least 5 minutes before running a Startup.

4. Turn the instrument OFF for about five seconds, then turn the instrument back ON again. The power ON sequence should now perform a Startup and background cycle. This sequence also establishes a Hgb blank reference which is used as a Hgb blank check during normal sample analysis.

Verification

1. Verify the Startup results passed. If the results do not pass, press **STARTUP** on the instrument keypad to repeat the Startup and background check.
2. Use a fresh normal whole-blood specimen to check instrument reproducibility.
   a. From the Main Menu, select **2. CALIBRATION ▸▸ 4. REPRODUCIBILITY**.
   b. Run eleven samples and then delete the first one for a ten-shot reproducibility.
   c. Verify the reproducibility results are within acceptable limits. See Table 3.2-1.

Table 3.2-1 Whole-Blood Reproducibility CV Limits for 20 Cycles

Parameter	%CV	Test Level
WBC	<2.0%	at 10.0 x 10^3/µL
RBC	<2.0%	at 5.00 x 10^6/µL
Hgb	<1.0%	at 15.0 g/dL
Hct	<2.0%	at 45.0%
MCV	<1.0%	at 90.0 fL
Plt	<5.0%	at 300 x 10^3/µL

3. Have the Customer perform the calibration procedure using the instructions in Chapter 7 of the Operator's Guide.

4. Verify the calibration factors are acceptable according to Table 3.2-2.

Table 3.2-2 Calibration Factors - Acceptable Range

Parameter	Minimum Acceptable Value	Maximum Acceptable Value
WBC	90	200
RBC	160	290
Hgb	25.0	55.0
Hct	160	290
Plt	180	400
RDW	0.1	0.9

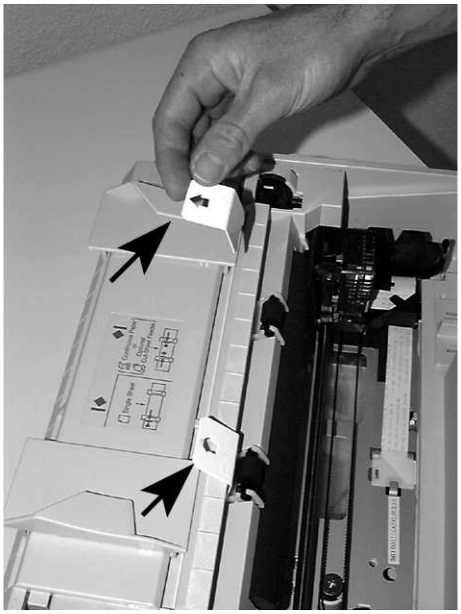
3.3 PRINTER INSTALLATION

EPSON® LX™- 300 and LX™- 300+ Printer Connection

Unpack the Printer

1. Unpack the printer and set it on a flat, stable surface.
2. Carefully remove all packing materials including the tabs shown in Figure 3.3-1.

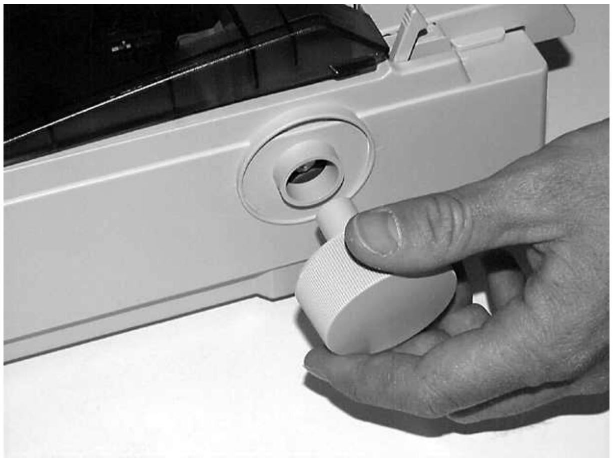
Figure 3.3-1 Carefully Remove All Packing Materials



Install the Knob

Install the paper-feed knob (Figure 3.3-2).

Figure 3.3-2 Paper-Feed Knob Installation



Install the Ribbon Cartridge

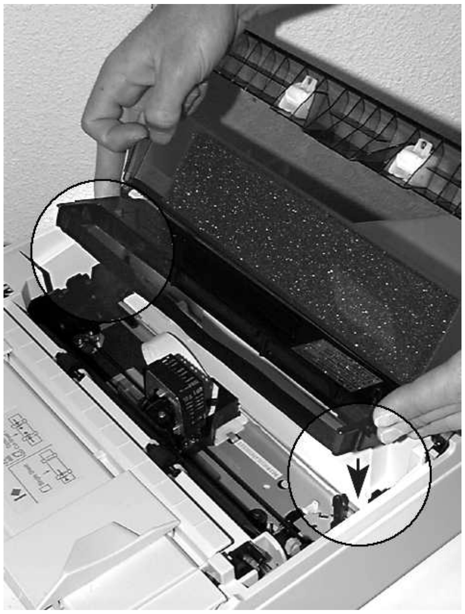
1. Open the printer cover to the upright position, then pull it up to remove it.

CAUTION Risk of damage to the printer. Never move the print head while the printer is turned on. Do not move the print head unless the power is turned OFF.

---

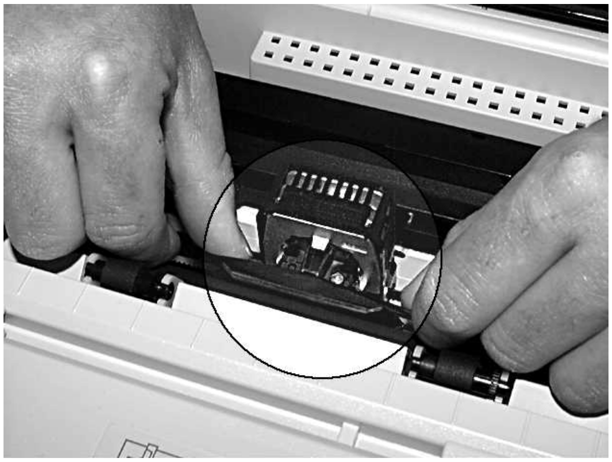
2. Slide the printer head to the middle of the printer.
3. Locate the ribbon cartridge and turn the ribbon-tightening know in the direction of the arrow to remove any slack from the ribbon.
4. Insert the ribbon cartridge into the printer as shown in Figure 3.3-3. Press both sides of the cartridge firmly to fit the plastic hooks into the printer slots.

Figure 3.3-3 Insert the Ribbon Cartridge



5. Guide the ribbon between the print head and ribbon guide (Figure 3.3-4).

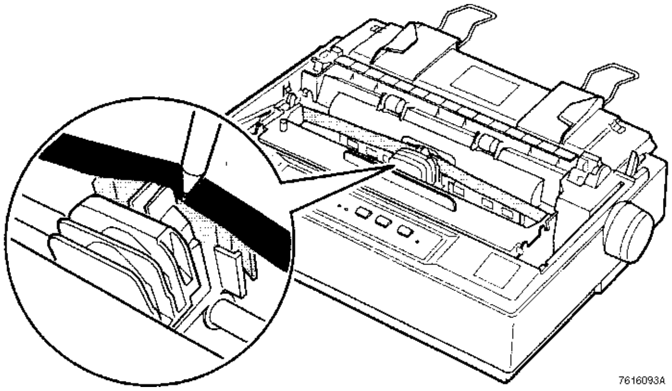
Figure 3.3-4 Threading the Ribbon



6. Make sure the ribbon is positioned between the print head and the ribbon guide. You may use a pointed object, such as a ball point pen to help guide it into place (Figure 3.3-5). Once in place, turn the ribbon tightening knob to help position the ribbon. It should not be twisted or creased.

   Note: This ribbon placement can also verified later when the paper is installed. If the ribbon is properly installed, the paper and ribbon do not make direct contact.

Figure 3.3-5 Proper Ribbon Placement



7. Manually slide the printer head from side to side to make sure it moves smoothly.

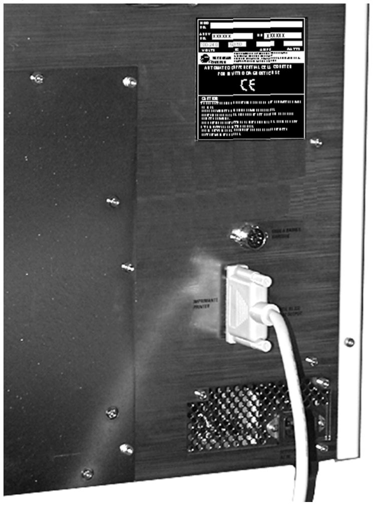
Connect the Printer

CAUTION Risk of damage to the instrument. Connecting the printer to the instrument with the power on could damage the instrument. Ensure the instrument's power is OFF before connecting the printer.

---

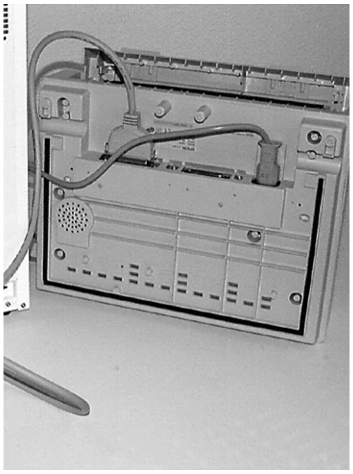
1. Make sure the instrument's power is off.
2. Locate the printer cable delivered with the instrument.
3. Notice that one connector has two screws and the other connector has two clips.
4. At the back of the instrument, attach the connector with the two screws to the connector located in the lower right corner of the instrument (Figure 3.3-6).

Figure 3.3-6 Cable Connection at the Instrument



5. Tighten the screws to secure the cable connection.
6. At the printer, lift the printer and set it on its side as shown in Figure 3.3-7.

Figure 3.3-7 Cable Connections



7. Attach the other end of the cable to the printer as shown in Figure 3.3-7. Lock the connector in place with its two side clips.
8. If a 220 Vdc printer is being installed, insert the power cord in the printer (Figure 3.3-7).

   Note: The power cord for the 120 Vdc printer is already attached.
9. If the laboratory will be using continuous feed printing, guide the interface cable and the power cord through the cable slots on the left and right sides of the printer to keep the cables from blocking the paper supply. Both cables can be routed to one side.
10. Set the printer flat on the table.
11. Plug the printer power cord into the ac power source.

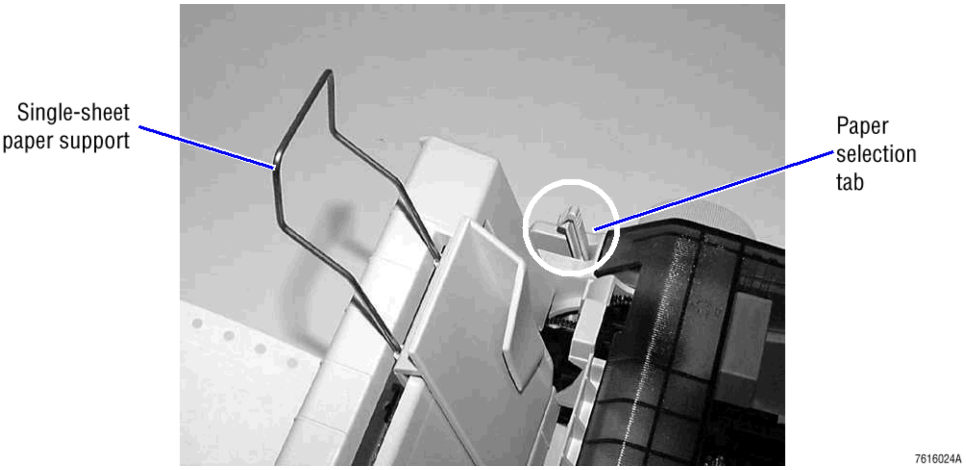
Paper Feed Options

An operator may choose continuous feed printing or printing on single sheets of paper. Set up the option your customer desires to use on a routine basis.

Single Sheet Paper Feed Setup

1. Install the paper supports as shown in Figure 3.3-8. Use this support only when printing on single sheets of paper is desired.
2. Set the paper selection tab to single sheet Figure 3.3-8.

Figure 3.3-8 Paper Support for Printing Single Sheets of Paper

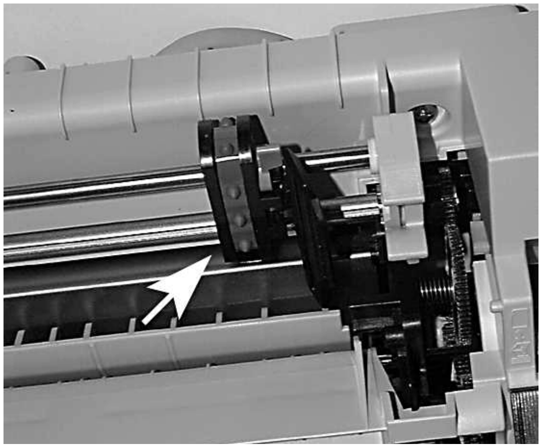


3. See the printer user manual for additional information.

Loading Continuous Feed Paper Feed

1. Place the paper selection tab to continuous feed Figure 3.3-8.
2. Make sure the printer is turned off.
3. Remove the paper guide that separates the incoming paper from the printed paper.
4. Release the sprocket units by pulling the sprocket locks forward (Figure 3.3-9).

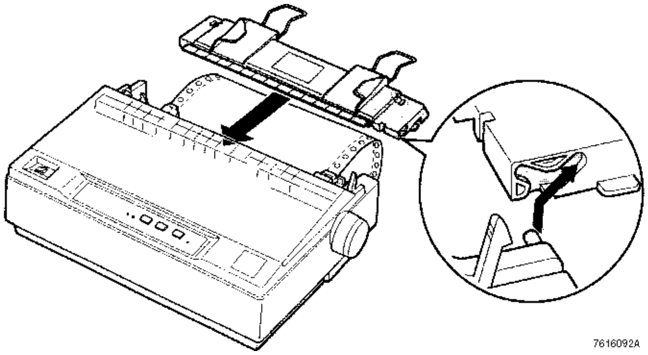
Figure 3.3-9 Printer Sprockets



5. The printer prints to the right of the position marked 0. Slide the left sprocket unit to position the paper then push the sprocket lock lever back to lock it in place. Slide the right sprocket unit to match the width of the paper, but do not lock it. Move the paper support so it is midway between the sprocket units.
6. Make sure the paper has a clean, straight leading edge. Open the sprocket covers. Fit the first holes of the paper over the sprocket pins and then close the sprocket covers.
7. Slide the right sprocket unit to remove any slack in the paper and lock it in place. Now the paper is in the paper-park position.

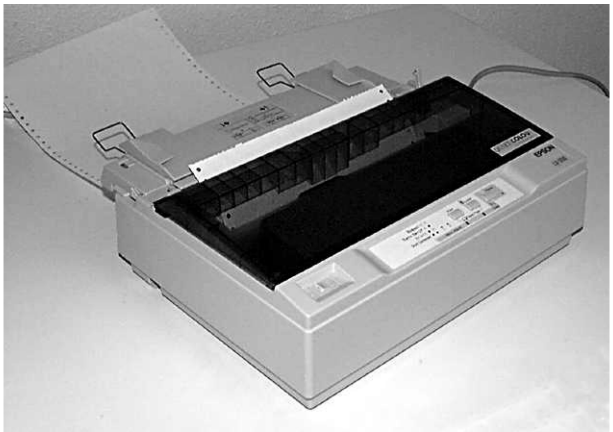
8. To separate the incoming paper from the printed paper, attach the paper guide by holding it horizontally and fitting its notches over the printer mounting posts (Figure 3.3-10). Slide the paper guide towards the front of the printer until you feel it click.

Figure 3.3-10 Replace Paper Guide



9. Slide the left and right paper edge guides (used for single sheets) to the center.
10. Close the printer cover (Figure 3.3-11).

Figure 3.3-11 Printer Ready for Continuous Feed Printing



11. Turn the printer ON.

CAUTION Risk of damage to the printer. Use the knob on the right side of the printer only to clear paper jams and only when the printer is off. Otherwise, you may damage the printer or cause it to lose the top-of-form position. Do not turn the printer knob unless the power is turned OFF.

---

12. Press the LF/FF button to feed the paper to the loading position.
13. Verify that the paper and the ribbon are not touching each other. If they are in direct contact, the ribbon is not installed correctly. Reposition the ribbon between the print head and ribbon guide (Figures 3.3-4 and 3.3-5).

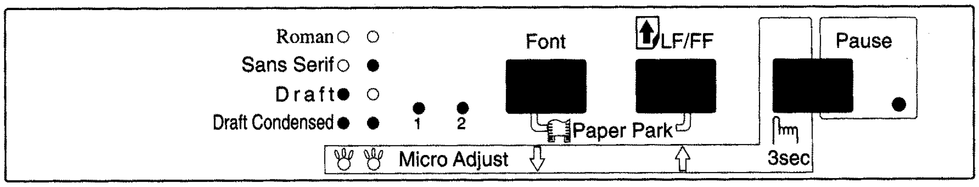
Configure the Printer

LX300 Printer

ATTENTION: The LX300 printer must be set to Draft mode to ensure printouts, such as patient result reports, are formatted correctly.

At the printer control panel (Figure 3.3-12), verify the printer is set to the Draft mode (the LED above the number 2 is glowing). If the LED is not glowing, press the **FONT** key until it does glow.

Figure 3.3-12 LX300 Printer Control Panel


Roman
Sans Serif
Draft
Draft Condensed
1
2
Font
LF/FF
Pause
Paper Park
Micro Adjust
3sec

When the printer receives data, it will begin printing automatically. For addional information, see the printer user manual.

LX300+ Printer

At the printer control panel (Figure 3.3-13), press and hold the **TEAR OFF** button while switching the printer On to access the parameter setup meni. Follow the printed instructions to setup the printer. The printer control functions and default settings are shown in Table 3.3-1 and Table 3.3-2.

Figure 3.3-13 LX300+ Printer Control Panel

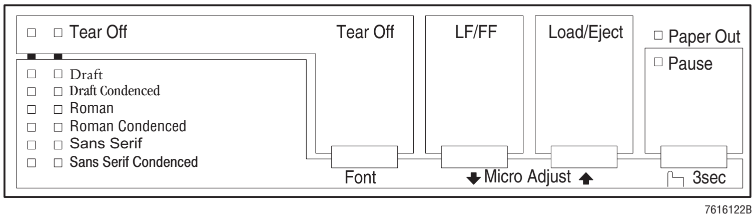

Tear Off
Draft
Draft Condenced
Roman
Roman Condenced
Sans Serif
Sans Serif Condenced
Tear Off
LF/FF
Load/Eject
Paper Out
Pause
Font
Micro Adjust
3sec
7616122B

Table 3.3-1 LX300+ Printer Controls and Indicators

Control/Indicator	Function
LF/FF button	• Feeds paper line by line when pressed and released. • Ejects a single sheet or advances continuous paper to the next top-of-form position when held down.
Load/Eject button	• Loads a single sheet of paper. • Ejects a single sheet of paper if a sheet is loaded. • Loads continuous paper backwards to the standby position. • Feeds continuous paper backwards to the standby position.

Table 3.3-1 LX300+ Printer Controls and Indicators *(Continued)*

Control/Indicator	Function
Paper Out light	- On when no paper is loaded in the selected paper source or paper is not loaded correctly. - Flashes when paper has not been fully ejected or a paper jam has occurred.
Pause light	- On when printer is paused. - Flashes when the printer is in the Micro Adjust mode. - Flashes when the print head has overheated.
Pause button	- Stops printing temporarily and resumes printing when pressed again. When pressed for 3 seconds, turns on the Micro Adjust mode*. To turn off the mode, press again.
Tear Off button†	- Advances continuous paper to the tear-off position. - Feeds continuous paper backward from the tear-off position to the top-of-form position.
Tear Off lights†	- Lights when continuous paper is in the tear-off position, otherwise the lamps indicate the selected font.

* In the Micro Adjust mode, press the **LF/FF** and **Load/Eject** buttons to adjust the top-of-form position.

† In Micro Adjust mode, press the **Tear Off** button to select the font to use for printing. The **Tear Off** lights turn on, off or flash to indicate the selected font.

Table 3.3-2 LX300+ Printer Default Settings

Page length for tractor	6 inch
Skip over perforation	Off
Auto tear Off	Off
Auto line feed	Off
Print direction	Bi-D
Software	ESC/P
0 slash	0
High speed draft	On
I/F mode	Auto
Auto I/F wait time	10 seconds
Baud rate	19200BPS
Parity	None
Parallel I/F bidirectional mode	On
Packet mode	Auto

Table 3.3-2 LX300+ Printer Default Settings *(Continued)*

Character table	PC 437
International character set for Italic table	Italic U.S.A.
Manual feed wait time	1.5 seconds
Buzzer	On
Auto CR (IBM 2380 Plus)	Off
IBM character table	Table2

Complete the Instrument Installation

Return to Heading 3.2, INITIAL SETUP and continue the installation starting at the Power On the Instrument heading.

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4.1 GUIDELINES FOR SERVICING THE A^{C}•T 5diff HEMATOLOGY ANALYZER

General Guidelines

Safety Precautions

Review and heed the general safety warnings and cautions listed under Heading 1.2, SAFETY PRECAUTIONS.

Accessibility

Ensure there is adequate space to work and to access the instrument components safely.

Electronic Precautions

WARNING Risk of personal injury. Contacting exposed electronic components while the instrument is attached to power can cause personal injury from electric shock. Power down completely before removing covers to access electronic components.

CAUTION Risk of damage to electronic components. If the power is ON while removing or replacing electronic components, the instrument could be damaged. To prevent damage to electronic components, always be sure power is OFF before removing or replacing printed circuit cards and components.

Before disconnecting or reconnecting any electronic component, turn the instrument off and disconnect the power cord from the instrument or the wall outlet. See Power Down / Power Up the Instrument in this section.

Environment Protection

If the A^{C}•T 5diff analyzer is old and ready for disposal, the instrument and its accessories must be collected by a company that specializes in the elimination or the recycling of laboratory equipment according to the legislation.

Procedures

WARNING Risk of personal injury or contamination. If you do not properly shield yourself while servicing the instrument with the doors or panels open, you may become injured or contaminated. To prevent possible injury or biological contamination, you must wear appropriate safety glasses, a lab coat, and gloves when servicing this instrument with the doors or panels open.

Adjustment and maintenance procedures that need to be done on the A^{C}•T 5diff hematology analyzer are in this section, including:

- Hydraulic maintenance and adjustments.
- Pneumatic maintenance and adjustments.
- Power supply maintenance and adjustments.
- Electronic maintenance and adjustments.

Note: Read each procedure entirely before beginning the service or repair.

Tools and Supplies

You can do most procedures using the standard Service Tool Kit and a digital voltmeter (DVM). Any special tools, supplies, or equipment required are identified under the Tools/Supplies Needed heading at the beginning of the procedure.

Instrument Performance Verification

When a service/repair procedure requires some type of instrument performance verification upon completion, a Verification heading is provided with the necessary steps that must be completed.

Service Password

CAUTION Risk of instrument damage. Do not disclose the Service password to a Customer. An untrained person with access to the Service menu may activate routines in an unauthorized order which may result in damage to critical systems such as the sample probe.

When performing some of the service and maintenance procedures, it will be necessary to use the Service menu. Access to this Service menu requires a password (which is actually a number) 239. The sequence for accessing the Service menu is:

1. From the Main Menu, select **4. DIAGNOSTICS ▸▸ 5. SERVICE**. The *SERVICE PASSWORD* prompt appears.
2. At the numeric keypad, press [**2**] [**3**] [**9**] then **ENTER**. The Service menu appears.
3. From the service menu, select the desired option.

User Mode

How to Disable the Right Side Door Interlock

WARNING Risk of personal injury. When SERVICE is selected as the User mode, the right side door interlock is bypassed allowing instrument operation with the right side door open. Avoid any unnecessary contact with the sample probe. The probe is sharp and may contain biohazardous materials. When the service call is complete, make sure the interlock is reactivated to ensure the Customer is not accidently injured by the sample probe or its movement.

SERVICE must be the selected User mode to operate the instrument with the right side door open. When the instrument is set to the Service mode, the interlock for the right side door is bypassed. To set the User mode to service:

1. From the Service menu, select **9. OTHERS ▸▸ 1. USER MODE.**
2. At the instrument keypad,
   a. Press the down arrow key to move the blinking cursor to the *SERVICE* box.
   b. Press the decimal point key. Make sure a dot appears inside the box.

      Note: If you press the decimal point too long, the dot may disappear. The dot inside the *SERVICE* box indicates the right side door interlock is bypassed.
   c. Press **ESC** to exit the User Mode screen.
   d. Press **ESC** as many times as necessary to return to the desired menu.

How to Reactivate the Right Side Door Interlock

When the service call is complete, make sure the right side door interlock is reactivated to ensure the Customer is not accidently injured by the sample probe or its movement. To reactivate the right side door interlock:

1. From the Service menu, select **9. OTHERS ▸▸ 1. USER MODE.**
2. At the instrument keypad,
    a. Press the down arrow key to move the blinking cursor to the *SERVICE* box.
    b. Press the decimal point key or the **DEL** key. Make sure the dot no longer appears inside the *SERVICE* box. The right side door interlock is reactivated.

       Note: If you press the decimal point too long, the dot may reappear. The dot inside the *SERVICE* box indicates the right side door interlock is bypassed.
    c. Press **ESC** as many times as necessary to return to the Main Menu.

Power Down / Power Up the Instrument

Purpose

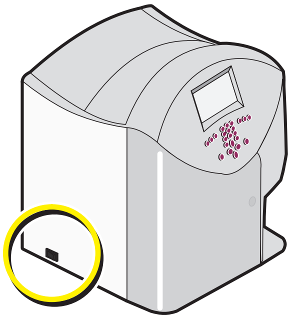
WARNING Risk of personal injury. Contacting exposed electronic components while the instrument is attached to power can cause personal injury from electric shock. Power down completely before removing covers to access electronic components.

Following the Power Down procedure ensures all power is removed from the instrument, preventing personal injury from electronic shock.

Power Down

1. Switch the Power On/Off rocker switch from ON (-) to OFF (O). This rocker switch is located at the base of the left side panel.

Figure 4.1-1 Location of the Power On/Off Rocker Switch



2. Unplug the ac power cord. Either remove the cord from the instrument (at the back panel, in the lower right corner) or from the ac wall outlet.

Power Up

1. Plug the ac power cord into the instrument (at the back panel, in the lower right corner) or the ac wall outlet, as applicable.
2. Switch the Power On/Off rocker switch from OFF (O) to ON (-). This rocker switch is located at the base of the left side panel.

   Note: An automatic Startup routine and background check is performed. If *MANUAL STARTUP* is the selected User Mode, an automatic Startup and background check does not occur. To initiate a Startup routine and background check, you must press the **STARTUP** button on the instrument keypad.

Reset the Instrument

Two instrument resets are available: System Reset Cycle and Hardware Reset.

System Reset Cycle

From the Main Menu, selecting **4. DIAGNOSTICS ▸▸ 1. SYSTEM RESET CYCLE** initiates the following actions:

- Checks all stepper motor positions
- Checks all sensors
- Drains and rinses the baths
- Cleans the sample probe
- Checks reagent volumes
- Fills the diluent reservoir
- Checks all mechanical functions

Hardware Reset

From the Main Menu, selecting **4. DIAGNOSTICS ▸▸ 4. HARDWARE SYSTEMS ▸▸ 1. HARDWARE RESET** moves all stepper motors to their home position.

4.2 OPENING OR REMOVING INSTRUMENT DOORS, PANELS, AND COVERS

Purpose

Use the procedures in this section for accessing instrument components. This access includes:

- Opening the Right Side Door
- Removing the Left Side Panel
- Removing the Rear Access Panel
- Removing the Top Cover
- Removing the Front Cover

Tools/Supplies Needed

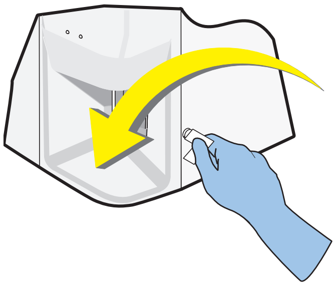
☐ Allen wrenches, 2.5 mm and 3 mm
☐ Screwdriver, T10 torx
☐ Locker key (provided)

Opening the Right Side Door

The pneumatic access door on the right side of the instrument allows the operator to access hydraulic assemblies for maintenance operations. This area is also called the bath enclosure. It is mandatory to keep the door locked during a cycle to ensure proper heating of the dilutions inside the baths. The door is secured using two captive screws that require a special key.

To open the door, place the edge of the key inside the screw slot and turn the captive screw counterclockwise (Figure 4.2-1).

Figure 4.2-1 Opening the Right Side Door



Bypassing the Right Side Door interlock

WARNING Risk of personal injury. When SERVICE is selected as the User mode, the right side door interlock is bypassed allowing instrument operation with the right side door open. Avoid any unnecessary contact with the sample probe. The probe is sharp and may contain biohazardous materials. When the service call is complete, make sure the interlock is reactivated to ensure the Customer is not accidently injured by the sample probe or its movement.

SERVICE must be the selected User mode to operate the instrument with the right side door open. When the instrument is set to the Service mode, the interlock for the right side door is bypassed. To set the User mode to service:

1. From the Service menu, select **9. OTHERS ▸▸ 1. USER MODE.**
2. At the instrument keypad,
    a. Press the down arrow key to move the blinking cursor to the *SERVICE* box.
    b. Press the decimal point key. Make sure a dot appears inside the box.

       Note: If you press the decimal point too long, the dot may disappear. The dot inside the *SERVICE* box indicates the right side door interlock is bypassed.
    c. Press **ESC** to exit the User Mode screen.
    d. Press **ESC** as many times as necessary to return to the desired menu.
3. When the service call is complete, make sure the right side door interlock is reactivated to ensure the Customer is not accidently injured by the sample probe or its movement. To reactivate the right side door interlock:
    a. From the Service menu, select **9. OTHERS ▸▸ 1. USER MODE.**
    b. At the instrument keypad,
        1) Press the down arrow key to move the blinking cursor to the *SERVICE* box.
        2) Press the decimal point key or the **DEL** key. Make sure the dot no longer appears inside the *SERVICE* box. The right side door interlock is reactivated.

           Note: If you press the decimal point too long, the dot may reappear. The dot inside the *SERVICE* box indicates the right side door interlock is bypassed.
        3) Press **ESC** as many times as necessary to return to the Main Menu.

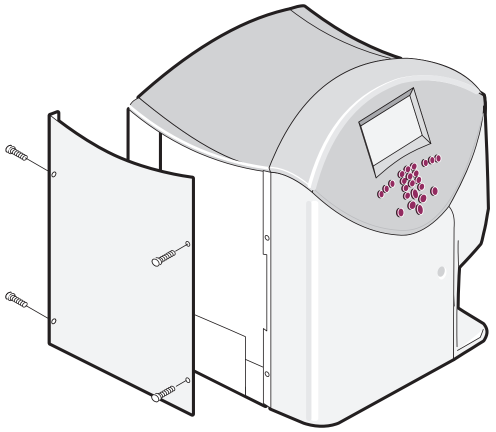
Removing the Left Side Panel

Removal

Remove the left side panel to gain access to the Main card:

1. Turn the instrument off and unplug the power cord from the instrument or the wall.
2. Remove the left side panel (Figure 4.2-2). Use a 3 mm hex key to remove the four hex screws securing the panel to the instrument frame.
3. Open the Main card door and carefully anchor the door behind the white plastic catch to keep it open.

Figure 4.2-2 Removing the Left Side Panel



Opening the Main Card Door

Opening the Main card door allows the operator to access hydraulic assemblies for maintenance operations.

1. To the right of the Main card, turn the two captive knobs counterclockwise to release the Main card door.

CAUTION A flat cable is connected to the rear of the Main card. Be careful when you open the door (where the Main card is attached) that you do not disconnect or damage this cable.

---

2. When opening the Main card door, carefully anchor the door behind the white plastic catch to keep it open.

Installation

1. Lift the white plastic catch to release the Main card.
2. Close the Main card door and turn the two captive knobs clockwise to secure it.
3. Replace the left side panel and install the four hex screws removed earlier.
4. Reconnect the power cord.
5. Turn the instrument on.

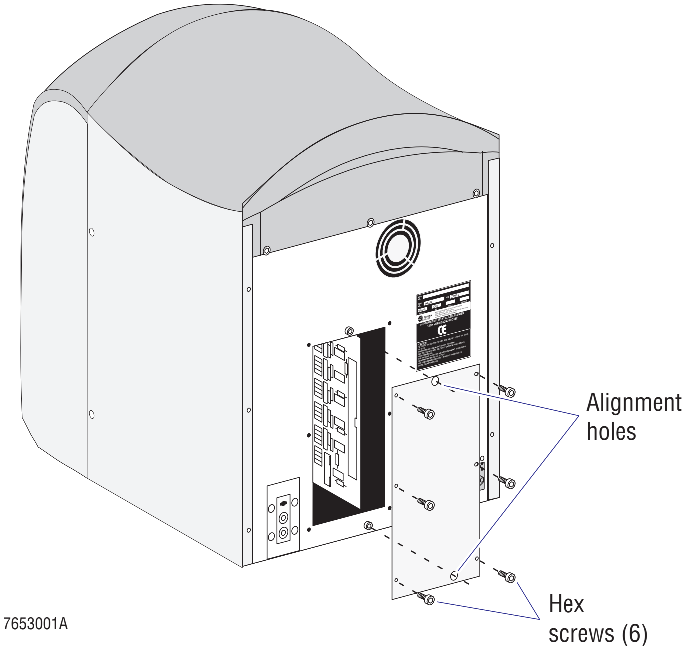
Removing the Rear Access Panel

The back panel provides access to the motors and sensor connectors on the Motor Interconnect card.

Removal

Use a 3.0 mm Allen key to remove the six hex screws securing the panel to the back of the instrument (Figure 4.2-3). Set the panel aside.

Figure 4.2-3 Rear Access Panel Screw Locations



Installation

This panel is not reversible, When replacing this panel, make sure the center opening at the top of the panel and the opening at the bottom of the panel are aligned as shown in Figure 4.2-3.

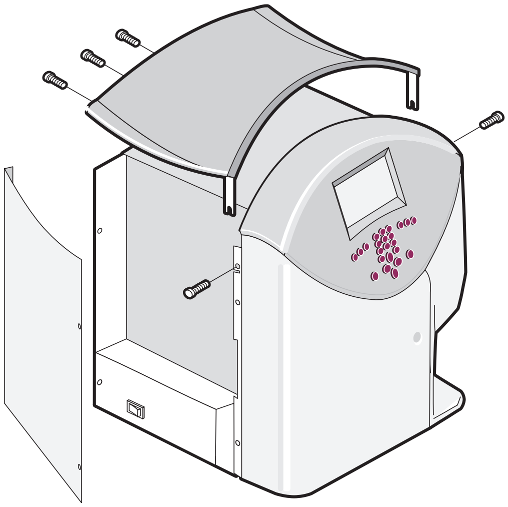
Removing the Top Cover

The top cover is secured to the instrument frame with five hex screws; three screws at the back of the instrument and one hex screw on each side of the instrument. The right door must be opened and the left panel must be removed before removing the top cover.

Removal

1. Turn the instrument off and unplug the power cord from the instrument or the wall.
2. Remove the left side panel. See Removing the Left Side Panel in this section.
3. In the left side compartment, remove the hex screw in the front upper corner (Figure 4.2-4).

Figure 4.2-4 Top Cover - Side Screw Locations



4. Open the right side door. See Opening the Right Side Door in this section.
5. In the right side compartment, remove the hex screw in the front upper corner (Figure 4.2-4).
6. At the rear of the instrument, remove the three hex screws securing the top cover to the instrument frame (Figure 4.2-4).
7. Carefully slide the cover back and off the instrument.
8. Set the cover aside.

Installation

1. Carefully position the top cover back on the instrument.
2. In the left side compartment, replace the hex screw in the front upper corner.
3. Open the right side door and replace the hex screw in the front upper corner.
4. At the rear of the instrument, replace the three hex screws that secure the top cover to the instrument frame.
5. Replace the left side panel and install the four hex screws removed earlier.
6. Close the right side door.
7. Reconnect the power cord.
8. Turn the instrument on.

Removing the Front Cover

The front cover requires that the right side door be opened, and the left side panel and top cover be removed.

Removal

1. Turn the instrument off and disconnect the power cord from the instrument or the wall.
2. Remove the top cover from the instrument. See Removing the Front Cover in this section.

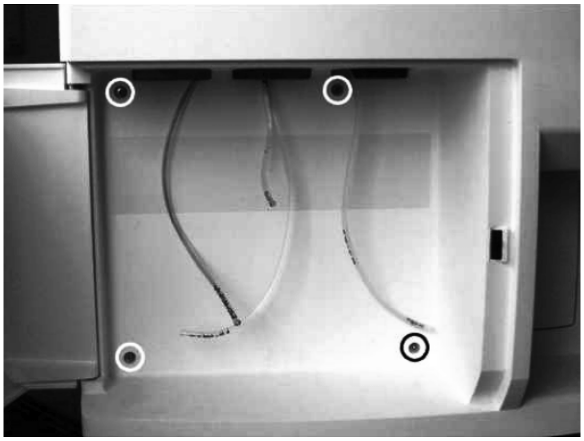
3. Open the reagent door and remove the four bottles.
4. Disconnect the tubing from the stopper.

CAUTION Risk of damage to the reagent compartment door. The two left screws inside the reagent compartment not only secure the compartment to the instrument frame but also secure the reagent compartment door. When these screws are removed, the door may fall. If the door becomes bent, it may not close properly. When removing the two left screws, hold the reagent compartment door securely to prevent it from falling when it detaches.

---

5. Unscrew the four hex screws shown in Figure 4.2-5. When removing the two left screws, hold the reagent compartment door securely to prevent it from falling when it detaches from the instrument.

Figure 4.2-5 Reagent Compartment Screw Locations



6. Make sure the sample probe is inside its housing then push the sample probe housing towards the back of the instrument.
7. Unscrew several turns the two torx screws shown in Figures 4.2-6 and 4.2-7.

Figure 4.2-6 Torx Screw Location Inside Front Panel

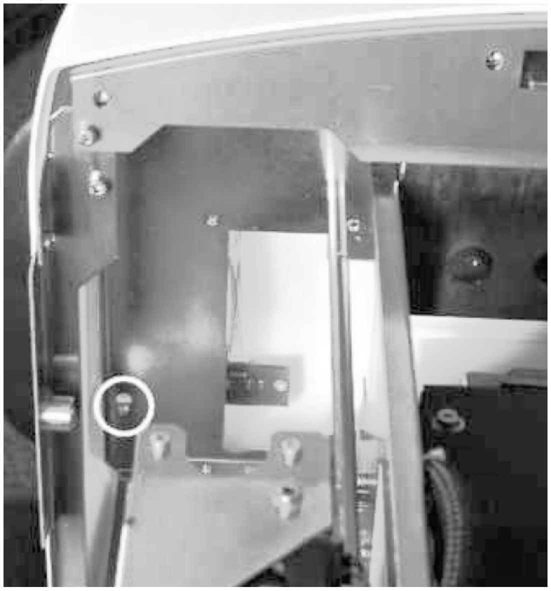
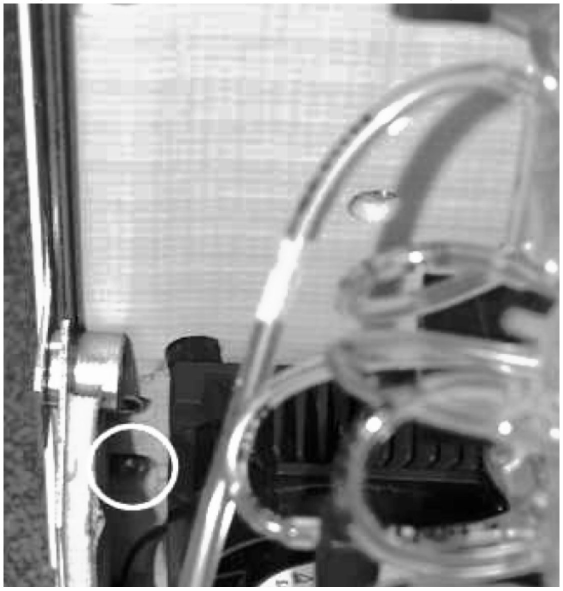
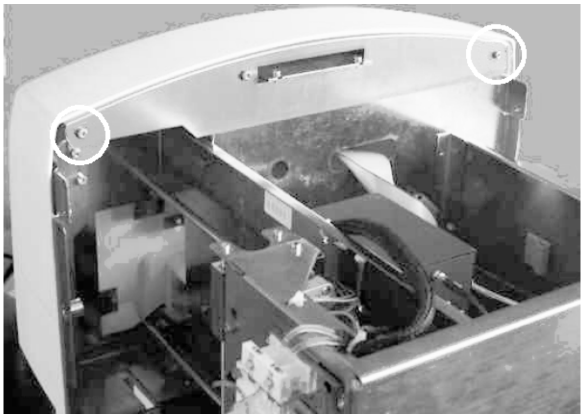


Figure 4.2-7 Torx Screw Location on Right Frame



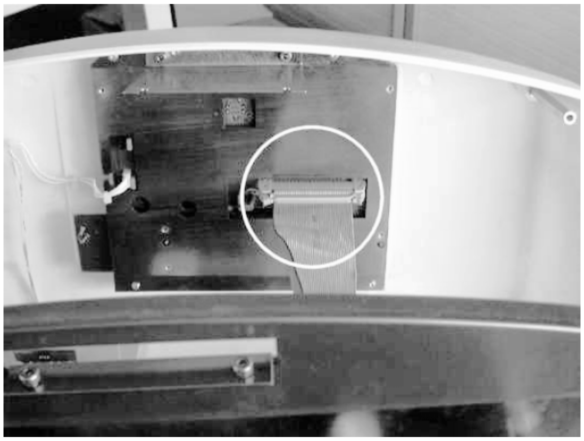
8. Unscrew the two hex screws shown in Figure 4.2-8.

Figure 4.2-8 Front Panel Screw Locations



9. Remove the flat connector attached to Keypad and LCD card (Figure 4.2-9).

Figure 4.2-9 Connector for the Keypad and LCD Card



10. Lift the front cover up and away slightly until the torx screws clear their holes then lift the cover off the instrument.
11. Set the cover aside in a safe place where it will not get damaged.

Installation

1. Position the front cover back on the instrument. Make sure the holes for the two torx screws are aligned with the screws that remained in the instrument.
2. Reattach the flat connector attached to Keypad and LCD card (Figure 4.2-9).
3. Replace the two hex screws located at the top inside the instrument (Figure 4.2-8).
4. Tighten the two torx screws shown in Figures 4.2-6 and 4.2-7.
5. Open the reagent door replace the four hex screws (Figure 4.2-5).
6. Reconnect the reagent tubing to its stopper and place the bottle back inside the reagent compartment (match the color coding on the bottle label with the label on the panel).

7. Replace the top cover. Under Removing the Front Cover, see the installation instructions.
8. Reconnect the power cord.
9. Turn the instrument on.

4.3 PREPARATION TO SHIP THE INSTRUMENT

Purpose

Use this procedure to clean and properly prepare the instrument for shipping.

Tools/Supplies Needed

- ☐ Fungicidal, bactericidal, virus killing detergent spray, non-corrosive for metals, non-plastic altering
- ☐ High quality, fragrance-free bleach (10-12% sodium hypochlorite - available chloride)
- ☐ Distilled water
- ☐ Absorbent paper
- ☐ Two 500 mL glass beakers or flasks

Bleach the Baths (20 minutes)

1. If OFF, turn the instrument ON.
2. From the Main Menu, select **4. DIAGNOSTICS ▸▸ 3. DILUTER SYSTEMS ▸▸ 4. EXTENDED CLEANING**. The Extended Cleaning prompt appears.
3. Press **ENTER** and the message *CYCLE IN PROGRESS. PLEASE WAIT. . .* appears.

WARNING Risk of contamination. If you do not properly shield yourself while decontaminating the instrument, you may become contaminated. To prevent possible biological contamination, you must wear appropriate safety glasses, a lab coat, and gloves when performing this procedure.

4. When the message *POUR 3 mL OF EXTENDED CLEANING REAGENTS INTO BATHS* appears,
    a. Open the right side door.
    b. Pour 3 mL of high quality, fragrance-free bleach (10-12% sodium hypochlorite - available chloride) into each bath.
    c. Close the right side door.
    d. Press **ENTER** to continue. Allow the instrument to complete the cleaning procedure. It takes about five minutes for the cycle to complete. The system will automatically flush to remove the bleach poured in the baths earlier.
5. When the cycle is finished, turn the instrument OFF and unplug the power cord from the instrument or the wall.
6. Open the right side door.
7. Spray the bactericidal cleaner on all biohazard areas and wait for 10 minutes (assemblies in contact with the biohazard materials such as instrument cover, tube holder, keypad, start key, assemblies close to the sample probe, and so forth).

Clean the External Surfaces (20 minutes)

1. Make a 1:5 bleach solution: 4 parts distilled water to 1 part high quality, fragrance-free bleach (10-12% sodium hypochlorite - available chloride).
2. Clean the work area around the instrument.

ATTENTION: Do not use a sponge or cloth to clean instrument assemblies. Use absorbent paper towels that can be discarded in a biohazard container. For small or sensitive assemblies, use lint-free tissues.

3. Use a spray detergent to remove blood stains and salt marks from the following assemblies:
    - Outer surfaces of the instrument (covers, LCD, reagent locations)
    - Keypad
    - Waste connector plug
    - Liquid valve push button
    - Assemblies close to the sample probe
    - Tube holder assembly
    - Overflow trays

ATTENTION: Do not bleach stainless steel components if the ambient room temperature is more than 30° C (86° F).

4. Disinfect, with the diluted bleach solution, all assemblies that have been in contact with biohazard materials.
5. Reinstall all the assemblies and set the instrument back to its initial configuration.

Clean the Tubing and Chambers (60 minutes)

Preparation

1. Locate two containers such as a glass beaker or flask that will hold a little more than 500 mL of liquid. Select containers that can be placed in front of the reagent compartment when the front door is open.
    a. In one container, prepare approximately 500 mL of a 1:10 bleach solution: 9 parts distilled water to 1 part high quality, fragrance-free bleach (10-12% sodium hypochlorite - available chloride).
    b. Pour 500 mL of distilled water into the second container.
2. Turn the instrument ON.
3. Remove each pickup tube from its reagent container and place the tube in the diluted bleach. Don’t forget the diluent pickup tube.
4. At the Main Menu, select **3. REAGENTS ▸▸ 3. PRIME ▸▸ 6. ALL REAGENTS** to pull the diluted bleach into the instrument.
5. Fill a glass or plastic tube with a 1:5 bleach solution: 4 parts distilled water to 1 part high quality, fragrance-free bleach (10-12% sodium hypochlorite - available chloride).

Cycle Routine

1. From the Service menu, select **7. BURN-IN**.
2. Set the number of burn-in cycles to **15**.
3. Cycle the 1:5 bleach solution to initiate the burn-in function. The instrument will cycle 15 times. Do not attempt to stop the cycles. Let the instrument operate until it stops.

Drain and Rinse

1. Remove the reagent pickup tube assemblies from the diluted bleach and wrap the tubes in absorbent paper.
2. From the Main Menu, select **3. REAGENTS** ▸▸ **3. PRIME** ▸▸ **6. ALL REAGENTS** to drain the diluted bleach from the system.
3. When the prime cycles are complete, select **6. ALL REAGENTS** again to ensure the bleach is removed from the system.
4. Exchange the diluted bleach container with the vessel containing distilled water and place the pickup tubes in the distilled water.
5. From the Prime menu, select **6. ALL REAGENTS** to rinse the system with distilled water.
6. Remove the reagent pickup tubes from the distilled water and wrap the tubes in absorbent paper.
7. From the Prime menu, select **6. ALL REAGENTS** to drain the distilled water from the system.
8. When the prime cycles are complete, select **6. ALL REAGENTS** again to ensure the distilled water is removed from the system.

WARNING When this process is complete, open the right side door and verify the DIFF bath is empty.

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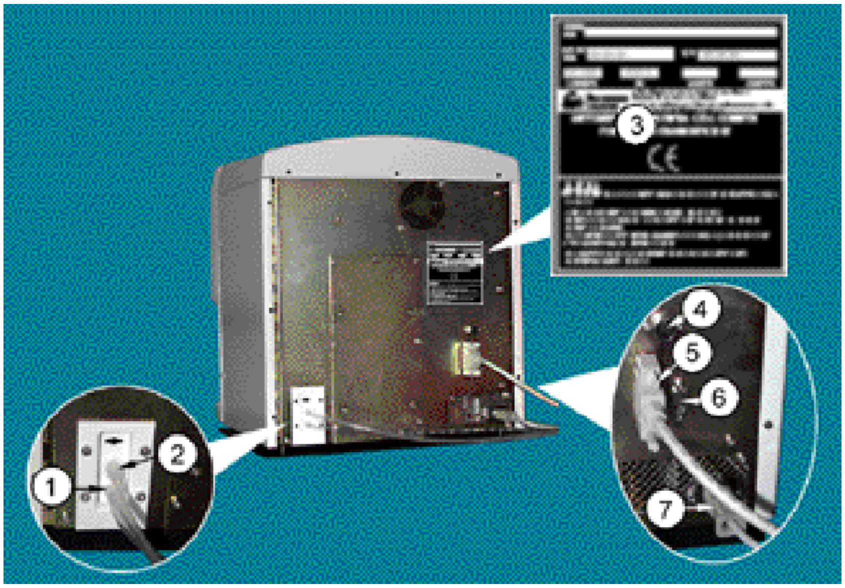
9. Turn the instrument OFF.
10. Remove the diluent input tubing (Figure 4.3-1, item 2).

Figure 4.3-1 Rear Panel Connections



WARNING Risk of contamination. If you do not properly shield yourself while removing the waste tubing, you may become contaminated. To prevent possible biological contamination, you must wear appropriate safety glasses, a lab coat, and gloves when removing this tubing.

11. Remove the waste output tubing (Figure 4.3-1, item 1).
12. Disconnect any cables attached to the back of the instrument including the:
    a. Bar-code reader connector, if attached (Figure 4.3-1, item 4).
    b. Printer connector (Figure 4.3-1, item 5).
    c. RS232C output, if attached (Figure 4.3-1, item 6).
    d. Power supply cable (Figure 4.3-1, item 7).
13. Verify that all four reagent bottles are removed from the reagent compartment.
14. Close all the instrument doors.
15. Pack the instrument in its original box, if available.

4.4 FLOW CELL CHECKS AND ADJUSTMENTS

Purpose

Use this adjustment procedure when the flow cell is moved or replaced, the DIFF tubing is changed, or the DiffPlot does not look correct. No adjustment should be required when the DIFF lamp is replaced.

To adjust the optical bench assembly, 5 µL of RBC/PLT latex is aspirated and diluted in the DIFF bath with 2 mL of diluent. This dilution is then injected into the flow cell. Once the Diff Adjustment screen appears, measurements are continuously displayed for 27 seconds with updates occurring every 700 microseconds. Adjustments may be made during this 27 seconds as needed. Three audible beeps indicate the end of the adjustment period. Do not make adjustments once these beeps are heard. The screen is no longer being updated.

Tools/Supplies Needed

- ☐ Allen wrench, 3 mm
- ☐ Plastic potentiometer adjustment tool, PN 5415364
- ☐ RBC/PLT latex, PN - LAD002AS
- ☐ Several fresh whole-blood specimens

Preparation

1. If off, turn the instrument on.
2. From the Main Menu, select **4. DIAGNOSTICS** ▸▸ **3. DILUTER SYSTEM** ▸▸ **2. RINSE** ▸▸ **2. FLOWCELL** to remove air bubbles clinging to the inner optical surfaces.
3. Press **ESC** twice to return to the Diagnostics menu then select **5. SERVICE**.

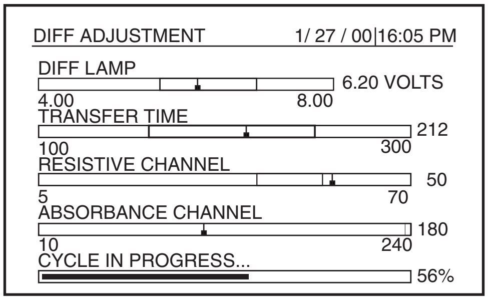
Flow Cell Checks

1. From the Service menu, select **2. MEASUREMENT** ▸▸ **5. DIFF ADJUSTMENT**.
2. When the *DIFF ADJUSTMENT* prompt appears, press **ENTER** to continue.

IMPORTANT Risk of misleading results. The RBC/PLT latex particles tend to clump as they settle out of solution. Clumped latex particles will affect adjustment results. Mix the RBC/PLT latex vigorously before use. A vortex may be used. Remix the latex thoroughly before each sampling.

3. Mix the RBC/PLT latex vigorously. Use a vortex, if available.
4. When the *PLEASE SAMPLE LATEX* prompt appears, present the vial of well-mixed latex particles to the probe and press the aspirate switch to initiate aspiration and the routine.
5. When the Diff Adjustment screen appears (Figure 4.4-1), verify each result is acceptable according to the following criteria:

Figure 4.4-1 Diff Adjustment Screen



DIFF ADJUSTMENT 1/ 27 / 00|16:05 PM
DIFF LAMP
6.20 VOLTS
4.00 8.00
TRANSFER TIME
212
100 300
RESISTIVE CHANNEL
50
5 70
ABSORBANCE CHANNEL
180
10 240
CYCLE IN PROGRESS...
56%

6. Verify the *DIFF LAMP* value displayed on the screen is between **5.50** and **6.50**.
   - If the value on the screen is within the acceptable range, go to step 7.
   - If the value on the screen is outside this acceptable range or or if you desire a value closer to the target value (6.0), go to the DIFF Lamp Voltage Adjustment heading.
7. Verify the *TRANSFER TIME* value is between **150** and **250**.
   - If the value on the screen is within the acceptable range, go to step 8.
   - If the *TRANSFER TIME* value is outside the acceptable range, there is a problem. Complete the instructions under Heading 4.36, OPTICAL BENCH PRELIMINARY ADJUSTMENTS before proceeding.

     Note: When cells are not optically detected, the *TRANSFER TIME* value displayed on the screen is 100 and backlighted. The backlighted number indicates the value is less than 100, and may actually be zero. If the flow cell is so far out of alignment that no cells are detected, the procedure under Heading 4.36 provides a series of preliminary adjustments for the flow cell and optics lamp.

     When the *TRANSFER TIME* value is greater than 100 but less than 149, the timing is outside the acceptable range but the number greater than 100 indicates that cells are definitely being detected. The *TRANSFER TIME* is controlled by the height of the flow cell relative to the level of the light beam. Since the light beam is at a fixed height with no vertical adjustment knob for the flow cell, this is a difficult adjustment. The height of the flow cell is controlled by the spacers or shims placed under the flow cell mounting block. Each shim moves the flow cell up a distance that equates to a 30 microsecond drop in the *TRANSFER TIME* value. A new flow cell is shipped with matching shims that should set it to the proper height. As a result, it is critical that these shims are always replaced anytime the flow cell is removed and replaced.
8. Verify the *RESISTIVE CHANNEL* value is between **45** and **55**.
   - If the value on the screen is within the acceptable range, go to step 9.
   - If the value on the screen is outside this acceptable range or if you desire a value closer to the target value (50), go to the Resistive Channel Adjustment heading.
9. Verify the *ABSORBANCE CHANNEL* value is greater than **170**.
   - If the value on the screen is acceptable, go to the Final Verification heading at the end of this section.
   - If the value on the screen is less than 170 or if you desire a higher value, go to the Absorbance Channel Adjustment heading.

DIFF Lamp Voltage Adjustment

Note: If you are only interested in the *DIFF LAMP* voltage, it it not necessary to aspirate latex. However, if you change the lamp voltage, the Transfer Time, Resistive Channel, and Absorbance Channel values must be checked using latex particles.

Preparation

1. Remove the left side panel and the top cover from the instrument. For details, see Heading 4.2. Set the left side panel and top cover aside.
2. Locate potentiometer R11 on the optical bench assembly (Figures 4.4-2 and 4.4-3). This is the potentiometer you will use to adjust the DIFF lamp voltage.

Figure 4.4-2 Potentiometer R11 - Location on the Optical Bench Assembly

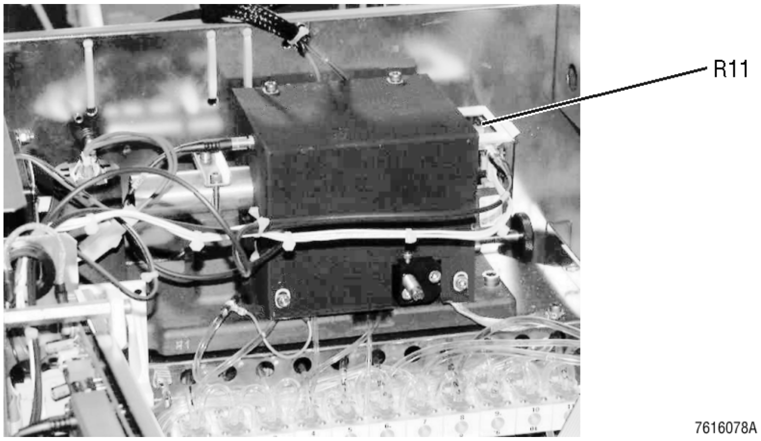
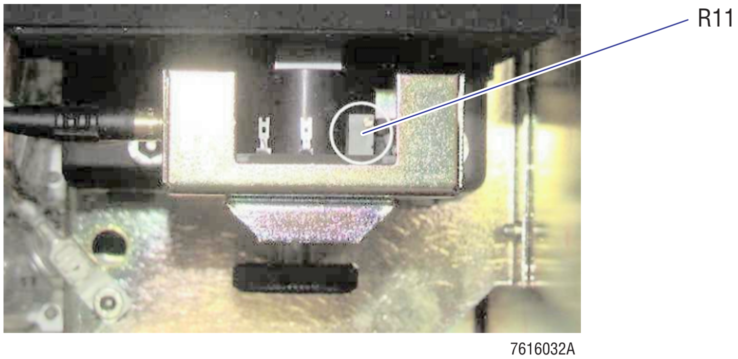


Figure 4.4-3 Potentiometer R11 Location - Top View from the Front of the Instrument



Adjustment

1. From the Service menu, select **2. MEASUREMENT ▸▸ 5. DIFF ADJUSTMENT**.

   Note: If the Diff Adjustment screen is currently displayed, press **ESC** to return to the Measurement Menu then select **5. DIFF ADJUSTMENT**.
2. When the *DIFF ADJUSTMENT* prompt appears, press **ENTER** to continue.

IMPORTANT Risk of misleading results. The RBC/PLT latex particles tend to clump as they settle out of solution. Clumped latex particles will affect adjustment results. Mix the RBC/PLT latex vigorously before use. A vortex may be used. Remix the latex thoroughly before each sampling.

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3. Mix the RBC/PLT latex vigorously. Use a vortex, if available.
4. When the *PLEASE SAMPLE LATEX* prompt appears, present the vial of well-mixed latex particles to the probe and press the aspirate switch to initiate aspiration and the routine
5. When the Diff Adjustment screen appears, monitor the *DIFF LAMP* value on the screen. 6.00 Vdc is the target value. The acceptable range is 5.50 to 6.50 Vdc.
6. If a change is desired, adjust potentiometer R11 (Figure 4.4-3) to produce a readout of 6.00 Vdc.

   Note: Measurements are continuously displayed for 27 seconds. The readout updates every 700 microseconds. Do not continue to make adjustments after the three audible beeps.
7. If more time is needed to make the adjustment,
   a. When the *CYCLE IN PROGRESS* timing bar disappears, press **ESC** to return to the Measurement menu.
   b. At the Measurement menu, select **5. DIFF ADJUSTMENT**.
   c. When the *DIFF ADJUSTMENT* prompt appears, press **ENTER** to continue.
   d. Mix the RBC/PLT latex vigorously. Use a vortex, if available.
   e. When the *PLEASE SAMPLE LATEX* prompt appears, present the vial of well-mixed latex particles to the probe and press the aspirate switch to initiate aspiration and the routine.
   f. When the Diff Adjustment screen appears, the monitoring and adjustment process can be continued for another 27 seconds until the three beeps sound.

Interim Verification

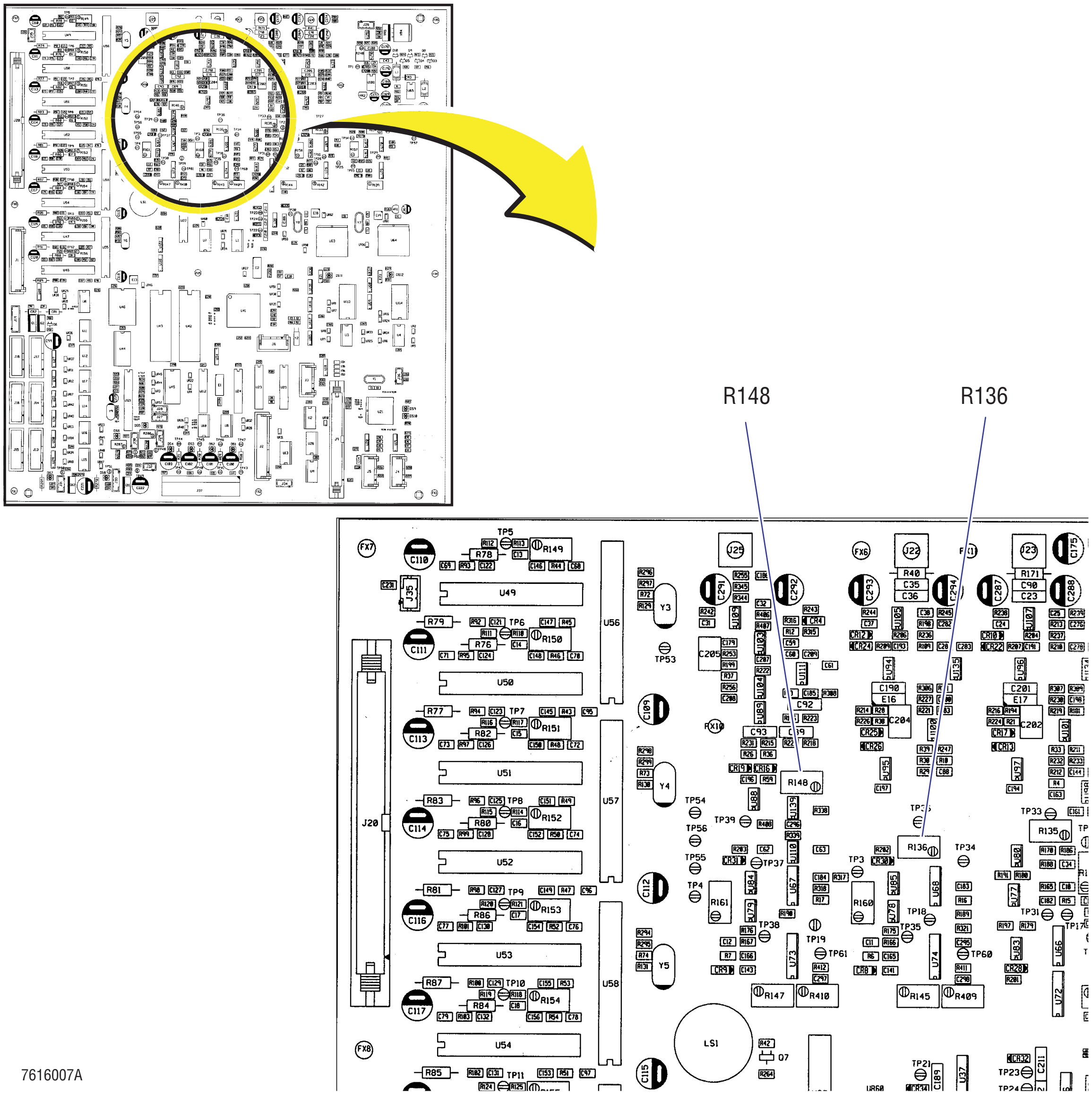
When the *DIFF LAMP* value is within the acceptable range of 5.50 to 6.50 Vdc, return to the Flow Cell Checks heading to verify this new setting and make sure all the other values are acceptable.

Resistive Channel Adjustment

Preparation

1. If you have not already done so, remove the left side panel from the instrument. For details, see Heading 4.2. Set the panel aside.
2. Locate potentiometer R136 on the Main card. See Figure 4.4-4.

Figure 4.4-4 Main Card Flow Cell Adjustments



Adjustment

1. From the Service menu, select **2. MEASUREMENT ▸▸ 5. DIFF ADJUSTMENT**.

   Note: If the Diff Adjustment screen is currently displayed, press **ESC** to return to the Measurement Menu then select **5. DIFF ADJUSTMENT**.

2. When the *DIFF ADJUSTMENT* prompt appears, press **ENTER** to continue.

IMPORTANT Risk of misleading results. The RBC/PLT latex particles tend to clump as they settle out of solution. Clumped latex particles will affect adjustment results. Mix the RBC/PLT latex vigorously before use. A vortex may be used. Remix the latex thoroughly before each sampling.

---

3. Remix the RBC/PLT latex vigorously. Use a vortex, if available.
4. Present the vial of well-mixed latex particles to the probe and press the aspirate switch to initiate aspiration and the adjustment routine.
5. When the Diff Adjustment screen appears, monitor the *RESISTIVE CHANNEL* value on the screen. 50 is the target value. The acceptable range is 45 to 55.

   Note: If the values are fluctuating, bubbles may be entering the flow cell. Purge the flow cell as follows:

   From the Main Menu, select **4. DIAGNOSTICS ▸▸ 3. DILUTER SYSTEM ▸▸ 2. RINSE ▸▸ 2. FLOWCELL** to remove air bubbles clinging to the inner optical surfaces.

6. If a change is desired, adjust potentiometer R136 until the channel is set at 50.

   Note: Measurements are continuously displayed for 27 seconds. The readout updates every 700 microseconds. Do not continue to make adjustments after the three audible beeps.

7. If more time is needed to make the adjustment,
   a. When the *CYCLE IN PROGRESS* timing bar disappears, press **ESC** to return to the Measurement menu.
   b. At the Measurement menu, select **5. DIFF ADJUSTMENT**.
   c. When the *DIFF ADJUSTMENT* prompt appears, press **ENTER** to continue.
   d. Mix the RBC/PLT latex vigorously. Use a vortex, if available.
   e. When the *PLEASE SAMPLE LATEX* prompt appears, present the vial of well-mixed latex particles to the probe and press the aspirate switch to initiate aspiration and the routine.
   f. When the Diff Adjustment screen appears, the monitoring and adjustment process can be continued for another 27 seconds until the three beeps sound.

Interim Verification

When the *RESISTIVE CHANNEL* value is within the acceptable range of 45 to 55, return to the Flow Cell Checks heading to verify this new setting and make sure all the other values are acceptable.

Absorbance Channel Adjustment

During this adjustment, the flow cell is repositioned so that the focal point of the light beam (which is fixed) is properly positioned inside the flow cell. The goal is to maximize the absorbance using a two-positional adjustment.

Preparation

1. If you have not already done so, remove the left side panel and the top cover from the instrument. For details, see Heading 4.2. Set the left side panel and top cover aside.
2. At the optical bench assembly, locate the front adjustment knob (Figure 4.4-5) and the side adjustment screw (Figure 4.4-6).
   - The Absorbance Channel adjustment is made using the front knob (Figure 4.4-5) or side screw (Figure 4.4-6) to move the flow cell.
   - An adjustment to move the flow cell along the Y-axis (front or back) is made using the front knob.
   - An adjustment to move the flow cell along the X-axis (right or left) is made using the side screw.

Figure 4.4-5 Front Adjustment Knob - Optical Bench

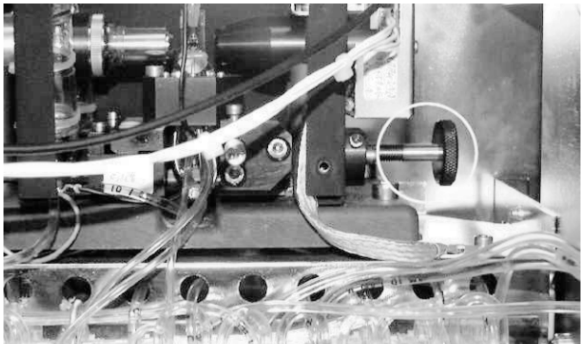
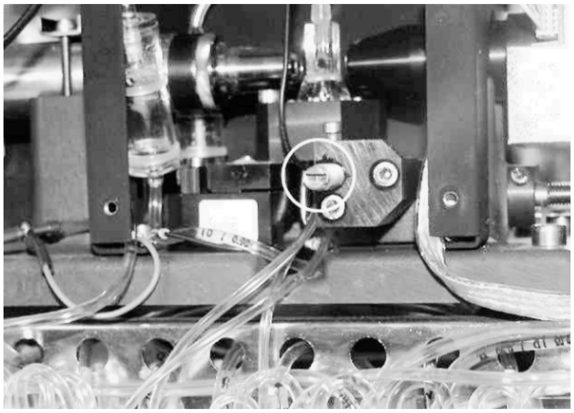


Figure 4.4-6 Side Adjustment Screw - Optical Bench



Adjustment

1. From the Service menu, select **2. MEASUREMENT ▸▸ 5. DIFF ADJUSTMENT**.

   Note: If the Diff Adjustment screen is currently displayed, press **ESC** to return to the Measurement Menu then select **5. DIFF ADJUSTMENT**.
2. When the *DIFF ADJUSTMENT* prompt appears, press **ENTER** to continue.

IMPORTANT Risk of misleading results. The RBC/PLT latex particles tend to clump as they settle out of solution. Clumped latex particles will affect adjustment results. Mix the RBC/PLT latex vigorously before use. A vortex may be used. Remix the latex thoroughly before each sampling.

3. Remix the RBC/PLT latex vigorously. Use a vortex, if available.
4. Present the vial of well-mixed latex particles to the probe and press the aspirate switch to initiate aspiration and the adjustment routine.

5. When the Diff Adjustment screen appears, verify the *ABSORBANCE CHANNEL* value is greater than 170.
6. If a change is desired, use the front knob (Figure 4.4-5) and the side screw (Figure 4.4-6) to adjust the channel higher than 170.

   Note: Measurements are continuously displayed for 27 seconds. The readout updates every 700 microseconds. Do not continue to make adjustments after the three audible beeps. If you have difficulties adjusting the absorbance high enough and the *DIFF LAMP* voltage value is acceptable, use potentiometer R148 on the Main card (Figure 4.4-4) to increase the gain. Final adjustment of potentiometer R148 is done during verification with fresh, normal whole-blood specimens.
7. If more time is needed to make the adjustment,
   a. When the *CYCLE IN PROGRESS* timing bar disappears, press **ESC** to return to the Measurement menu.
   b. At the Measurement menu, select **5. DIFF ADJUSTMENT**.
   c. When the *DIFF ADJUSTMENT* prompt appears, press **ENTER** to continue.
   d. Mix the RBC/PLT latex vigorously. Use a vortex, if available.
   e. When the *PLEASE SAMPLE LATEX* prompt appears, present the vial of well-mixed latex particles to the probe and press the aspirate switch to initiate aspiration and the routine.
   f. When the Diff Adjustment screen appears, the monitoring and adjustment process can be continued for another 27 seconds until the three beeps sound.

Interim Verification

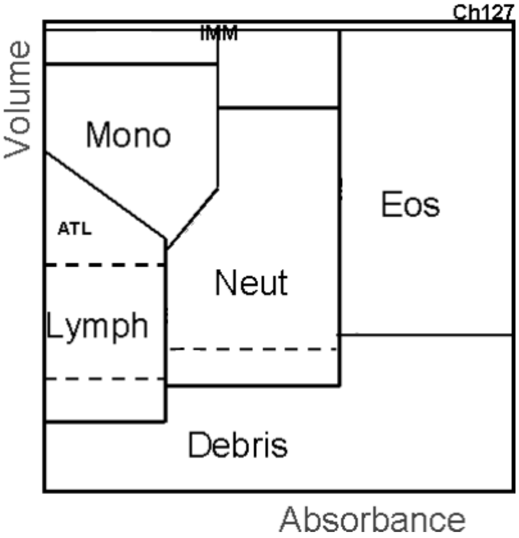
When the *ABSORBANCE CHANNEL* value is greater than 170, return to the Flow Cell Checks heading to verify this new setting and make sure all the other values are acceptable.

Final Verification

When all adjustments are complete,

1. If the optical bench cover was removed, replace the cover and secure it with the four screws removed earlier.
2. Make sure the right side door is closed.
3. Cycle several fresh normal whole-blood specimens (five different specimens, if possible) and verify the DiffPlot looks acceptable. It is particularly important that the lymphocyte and neutrophil population positions (Figure 4.4-7) meet the following criteria:

Figure 4.4-7 DiffPlot Regions



- The lymphocyte population must fall between the dotted lines representing normal lymphocytes (area labeled Lymph). Very few, if any, cells should be located in the small lymphocyte area (unlabeled area under the lower dotted line) or in the atypical lymphocyte area (area labeled ATL above the upper dotted line). See Figure 4.4-7.

  Move the lymphocyte population up or down by adjusting potentiometer R136 as needed (Figure 4.4-4). Base this resistive channel adjustment on several bloods, just in case the population of a specific blood is not as normal as you think.
- The vertical line separating the lymphocyte (area labeled Lymph) and neutrophil (Neut) populations must bisect those two populations. See Figure 4.4-7.

  If needed, use potentiometer R148 (Figure 4.4-4) to adjust the absorbance channel until the two populations are distinct and separated by the line.

4. If it was necessary to adjust either the resistive channel or the absorbance channel, recheck the diff adjustments as follows:
   a. From the Service menu, select **2. MEASUREMENT ▸▸ 5. DIFF ADJUSTMENT**.

      Note: If the Diff Adjustment screen is currently displayed, press **ESC** to return to the Measurement Menu then select **5. DIFF ADJUSTMENT**.
   b. When the *DIFF ADJUSTMENT* prompt appears, press **ENTER** to continue.

IMPORTANT Risk of misleading results. The RBC/PLT latex particles tend to clump as they settle out of solution. Clumped latex particles will affect adjustment results. Mix the RBC/PLT latex vigorously before use. A vortex may be used. Remix the latex thoroughly before each sampling.

---

c. Mix the RBC/PLT latex vigorously. Use a vortex, if available.

d. When the *PLEASE SAMPLE LATEX* prompt appears, present the vial of well-mixed latex particles to the probe and press the aspirate switch to initiate aspiration and the routine.

e. Verify the channel results appearing on the Diff Adjustment screen are acceptable:

- *RESISTIVE CHANNEL* value is between **45** and **55**.
- *ABSORBANCE CHANNEL* value is greater than **170**.

Note: If any value falls outside the acceptable range, the whole-blood specimens may not be normal or there may be an instrument problem affecting the DiffPlot. Timing, dilutions, noise, bubbles, or reagent can affect performance. Troubleshoot as needed.

5. When system performance is acceptable,

a. Carefully close the Main card door. Turn the two captive knobs clockwise to secure the door.

b. Replace the top cover if it was removed. See Heading 4.2 as needed.

ATTENTION: When replacing the left side panel with the instrument powered on, avoid accidently turning the instrument off again by carefully positioning the opening for the power on/off rocker switch over the switch as you position the panel on the instrument frame.

c. Replace the left side panel and install the four hex screws that secure it to the instrument frame.

6. Perform a system verification. See Heading 5.3, SYSTEM VERIFICATION PROCEDURES.

4.5 BATHS ASSEMBLY ALIGNMENT CHECK AND ADJUSTMENT

Purpose

Use this procedure to properly position the baths assembly anytime the assembly is either moved or replaced. Avoid any unnecessary contact with the sample probe. The probe is sharp and may contain biohazardous materials.

Tools/Supplies Needed

- ☐ Allen wrench, 3 mm
- ☐ Feeler gauges, optional
- ☐ Flashlight, optional

Preparation

1. If off, turn the instrument on.
2. From the Main Menu, select **4. DIAGNOSTICS ▸▸ 4. HARDWARE SYSTEMS ▸▸ 4. TRAVERSE SERVICE POSITION**.
3. When the *TRAVERSE SERVICE POSITION* prompt appears, press **ENTER** to retract the probe and move the housing over the bath assembly.
4. Turn the instrument off and unplug the power cord from the instrument or the wall.
5. Open the pneumatic access door (right side of the instrument).

Alignment Check

WARNING Risk of personal contamination. If you do not properly shield yourself while servicing the baths assembly, you may become contaminated. To prevent possible biological contamination, you must wear appropriate safety glasses, a lab coat, and gloves when servicing the baths assembly.

---

1. Using the horizontal traverse belt, manually position the sample probe housing over the inside rim of the rinse bath.

2. Gently push down on the top of the sample probe until the tip of the probe rests on the inside rim of the rinse bath (Figure 4.5-1 and Figure 4.5-2).

Figure 4.5-1 Sample Probe Position at the Rinse Bath

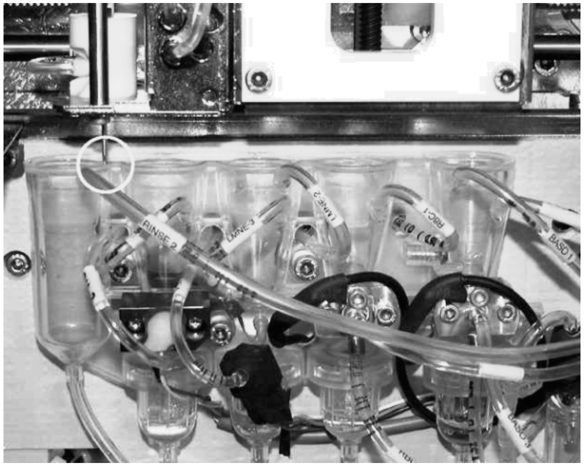
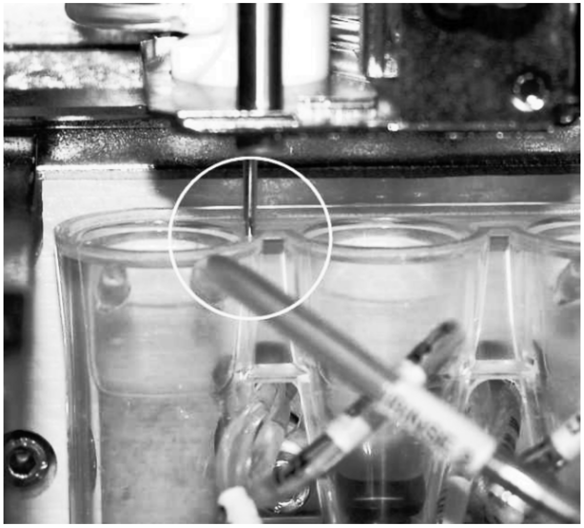


Figure 4.5-2 Close-up of Probe Position



CAUTION Risk of damage to the sample probe. If power is restored to the instrument and the baths assembly is mounted too high, the sample probe may become bent when it hits the bath edges as it moves from bath to bath. Do not restore instrument power until the baths assembly is aligned.

---

3. Verify the tip of the sample probe evenly clears the top of each bath:

   ATTENTION: If you have removed and replaced the baths assembly, be careful that you do not bend the probe as you move it towards the WBC/BASO bath.

   a. Without lifting the probe, gently push the probe housing towards the inside edge of the last bath, the WBC/BASO bath.
   b. Note the distance between the tip of the probe and the top of each bath as you move towards the WBC/BASO bath (Figures 4.5-3 and 4.5-4).

Figure 4.5-3 Sample Probe at the WBC/BASO Bath

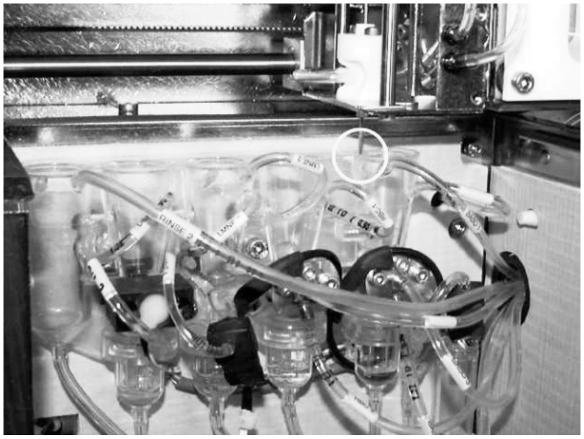
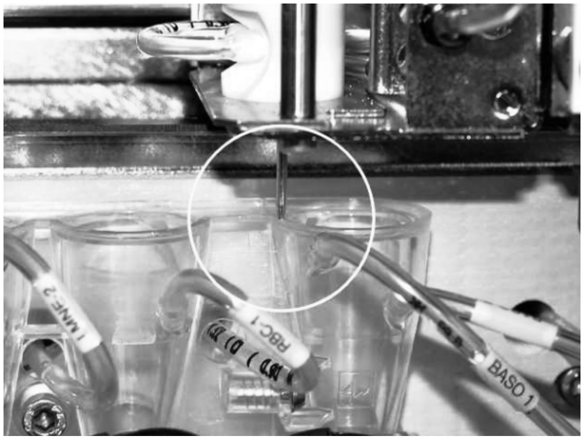


Figure 4.5-4 Close-up of Probe at the WBC/BASO Bath

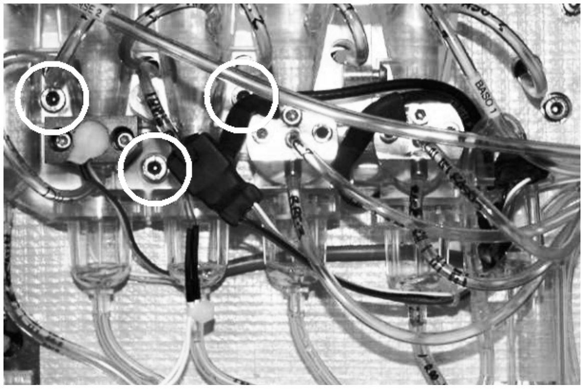


4. If the distance differs, do the Alignment Adjustment that follows.

Alignment Adjustment

1. Loosen, but do not remove, the three hex screws securing the baths assembly to the support panel (Figure 4.5-5). Use a 3 mm Allen wrench.

Figure 4.5-5 Location of Screws Securing the Baths Support Panel



2. Manually push the sample probe housing to the outside edge of the rinse bath. Move the baths assembly up or down as necessary until the tip rests gently on the outside rim of the rinse bath.
3. While continuing to push the sample probe housing over the rinse bath to the inside edge of the bath, adjust the baths assembly up or down as needed so that the sample probe tip comes to rest gently on the inside rim of the rinse bath as shown in (Figures 4.5-6 and 4.5-7).

Figure 4.5-6 Sample Probe Position at the Rinse Bath

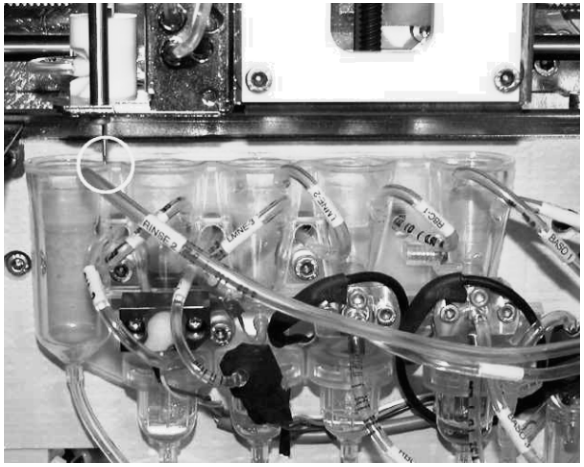
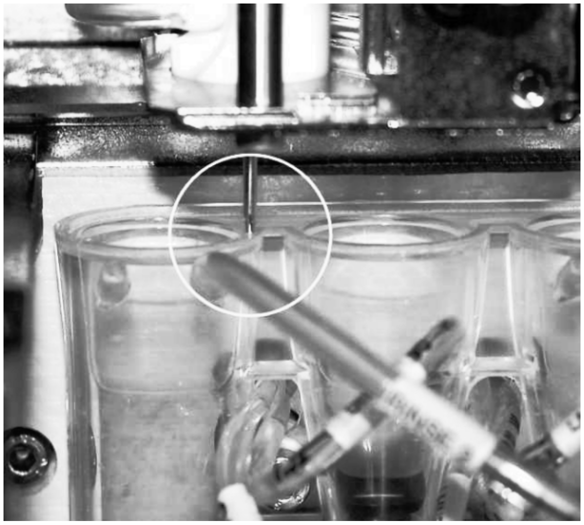


Figure 4.5-7 Close-up of Acceptable Probe Position



4. Gently tighten the center and left screws (See Figure 4.5-5).
5. Without lifting the probe, gently push the probe housing backwards towards the inside edge of the last bath, the WBC/BASO bath. Reposition the baths assembly as needed to clear the edge of each bath.

6. Verify the sample probe is positioned at the WBC/BASO bath as shown in Figure 4.5-8 and Figure 4.5-9.

Figure 4.5-8 Sample Probe Position, Right Side

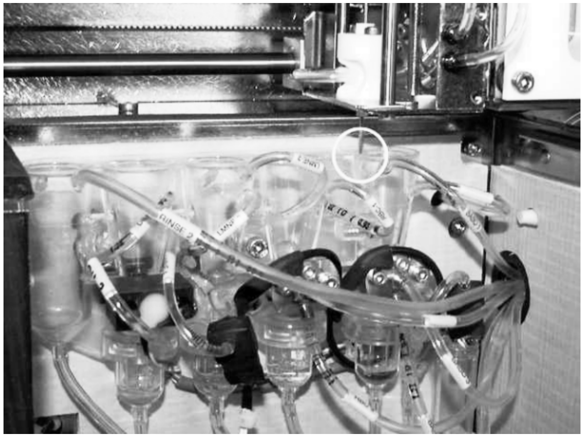
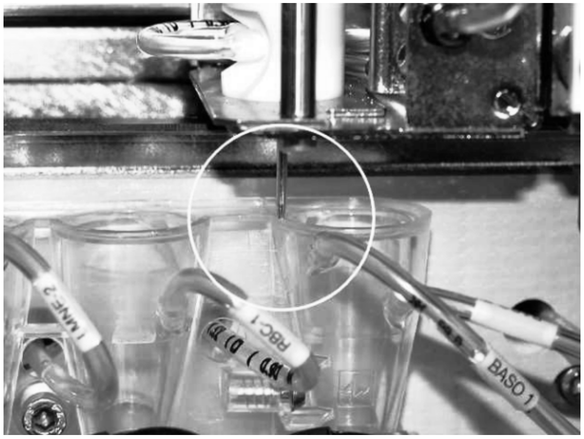


Figure 4.5-9 Close-up of Acceptable Probe Position



7. Gently tighten the right screw on the baths assembly (See Figure 4.5-5).
8. Make sure all three screws are tight so that the baths assembly is secure on the instrument's frame.
9. Carefully move the sample probe housing over the outer edge of the rinse bath. The probe should equally clear all baths. If not, loosen the nearest screw and reposition the baths assembly until the distance between the tip of the probe and the top of each bath is the same.

Verification

1. Go back to the Alignment Check heading and perform this check to verify proper alignment.

CAUTION It is mandatory to perform the probe adjustment procedure after this adjustment.

---

2. When the adjustment is correct
   a. Reconnect the power cord.
   b. Turn the instrument on. An automatic startup and background check are performed.
   Note: When the startup routine and background check are done, the sample probe will be back in its home position.
   c. Go to Heading 4.6, SAMPLE PROBE CHECKS AND ADJUSTMENTS and perform the probe adjustment procedure.

4.6 SAMPLE PROBE CHECKS AND ADJUSTMENTS

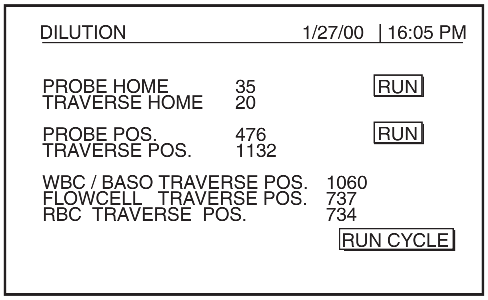
Purpose

IMPORTANT Check the baths assembly alignment before checking or adjusting the sample probe position. See Heading 4.5, BATHS ASSEMBLY ALIGNMENT CHECK AND ADJUSTMENT.

Use this procedure to check the sample probe home position and the sample probe position inside each bath. An adjustment procedure is provided after the check procedures. The check procedures may be done at any time, but the adjustment procedures should be performed only if the check fails.

From the Service menu, selecting **1. DILUTION** provides the options needed to adjust the traverse and sample probe (Figure 4.6-1.)

Figure 4.6-1 Dilution Screen



DILUTION 1/27/00 | 16:05 PM

PROBE HOME 35
TRAVERSE HOME 20

PROBE POS. 476
TRAVERSE POS. 1132

WBC / BASO TRAVERSE POS. 1060
FLOWCELL TRAVERSE POS. 737
RBC TRAVERSE POS. 734

dilution.eps

- **PROBE HOME**: Allow adjustment to get the best probe extremity cleaning.
- **TRAVERSE HOME**: Default value is 20 and does not need to be changed.
- **PROBE POS.**: Probe up/down adjustment.
- **TRAVERSE POS.**: Probe left/right position based on Traverse Home.
- **RUN**: Upper prompt positions the probe to determine if the tip of the sample probe is properly positioned 9.4 mm from its guide.
- **RUN**: Lower prompt positions the probe to determine if the tip of the sample probe is properly aligned with the DIFF bath at port 3.
- **RUN CYCLE**: Selection initiates a routine that provides a way to determine if the tip of the sample probe is properly aligned inside each of the baths. This routine is similar to an actual sample cycle.
- **WBC/BASO TRAVERSE POS.**: Probe left/right position in the WBC/BASO bath relative to the DIL1/HGB bath position. Adjusts distance from DIL1/HGB bath to WBC/BASO bath.
- **FLOWCELL TRAVERSE POS.**: Probe left/right position in the DIFF bath relative to the WBC/BASO bath. Adjusts distance from WBC/BASO bath to DIFF bath.
- **RBC TRAVERSE POS.**: Probe left/right position in the RBC bath relative to the DIFF bath. Adjusts distance from DIFF bath to RBC bath.

Tools/Supplies Needed

- ☐ Feeler adjustment gauge, 9.4 mm, or a sturdy piece of paper cut exactly 9.4 mm (0.37 in.) wide and approximately 76.2 mm (3.0 in.) long
- ☐ Plastic transfer pipet
- ☐ Flashlight, optional
- ☐ Jeweler's loop (x5 power magnifier with 2-inch focal length), optional

Sample Probe Checks

Use this procedure to check the home position of the sample probe and the probe's position inside each bath.

Home Position Check

1. From the Service menu, select **1. DILUTION**.
2. At the Dilution screen, select the upper *RUN* option and press **ENTER**.
3. Open the right side door
4. Verify the distance between the tip of the sample probe and the traverse is about 9.4 mm. Use either the feeler gauge or the 9.4 mm side of the paper you may have prepared. See Figures 4.6-2 and 4.6-3.

Figure 4.6-2 Acceptable Distance between the Sample Probe Tip and the Traverse

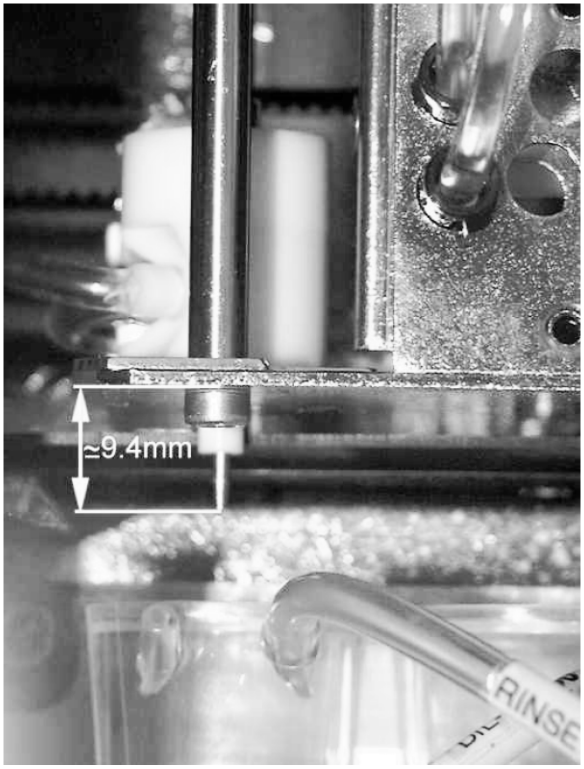
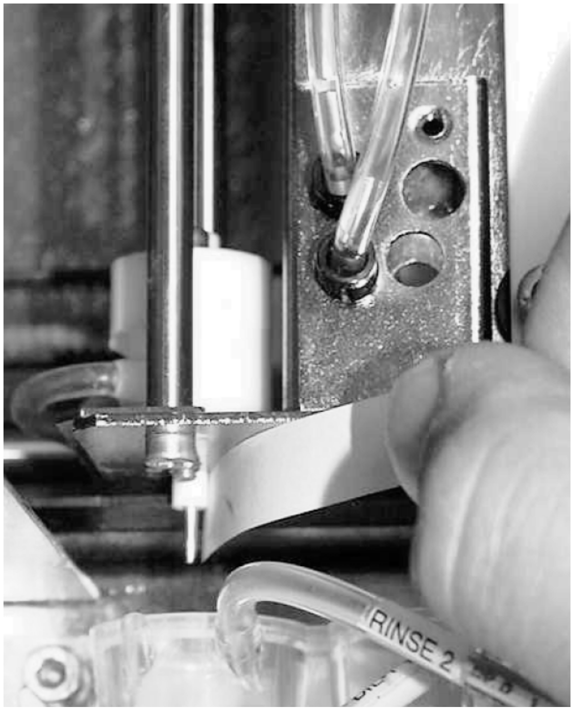


Figure 4.6-3 Measuring the Distance between the Sample Probe Tip and the Traverse



- If the distance is approximately 9.4 mm, press **ESC** then proceed to the heading Inside Bath Position Check.
- If the distance is unacceptable, continue to the Home Position Adjustment heading to perform the adjustment procedure.

Inside Bath Position Check

1. At the Dilution screen, select the *RUN CYCLE* option at the bottom of the screen.
2. Remove the tubing connected to port 1 of the DIL1/HGB bath, port 3 of the DIFF bath, port 1 of the RBC bath and port 2 of the WBC/BASO bath. These ports are located on the right side of each bath about 1cm (1/2 inch) from the top.
3. Clean the ports of any fluid that may affect your line of sight through the port. A plastic transfer pipet may be used to clear the ports.
4. With the following considerations in mind, evaluate the position of the probe tip in relation to the bath port.
    - Consider using a jeweler's loop (x5 power magnifier with 2-inch focal length) and a flashlight. These tools greatly enhance the image.
    - To make a proper judgement, your eyes must be correctly positioned.
    - The correct position for your eyes is when the port looks like Figure 4.6-4. If the circles are not centered (as in Figure 4.6-5), reposition your gaze until the circles are centered (as in Figure 4.6-4).

Figure 4.6-4 Correct View through the Port

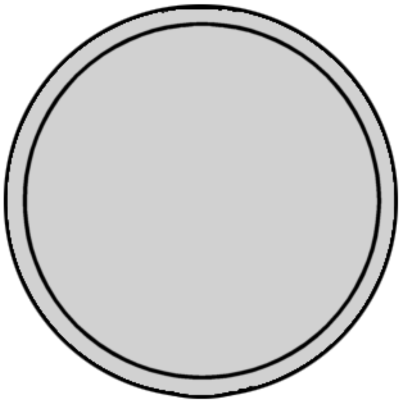
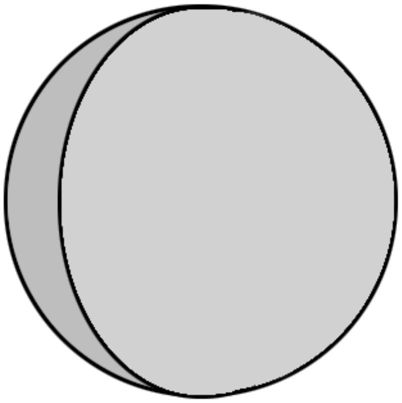
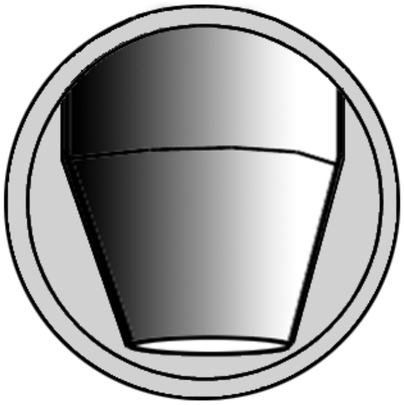


Figure 4.6-5 Incorrect View through the Port



    - As you gaze through the port, the tip of the sample probe should mimic the position of the tip shown in Figure 4.6-6, in each bath. The first bath is the DIL1/HGB bath. Press **ENTER** to advance to the WBC/BASO bath and then again for the DIFF bath and the RBC bath. Check that the probe position is correct in each bath.

Figure 4.6-6 Properly Adjusted Sample Probe Tip



5. If the probe is properly adjusted for all baths, reconnect the tubing to the bath ports. If the probe is out of adjustment, continue on to the heading Inside Bath Position Adjustment and follow the instructions to properly adjust the position of the probe.

Sample Probe Adjustments

Use this procedure to adjust the home position of the sample probe and the probe's position inside each bath.

Home Position Adjustment

CAUTION Check the probe position using the RUN functions before making an adjustment.

---

1. Thoroughly clean the exterior of the probe before making any adjustments.
2. At the Dilution screen, select the upper *RUN* option and press **ENTER**.
3. Use the 9.4 mm side of the paper to recheck the distance between the tip of the sample probe and the traverse to confirm the gap is incorrect. See Figures 4.6-2 and 4.6-3.
4. Press **ESC** to cancel the previous function.
5. At the Dilution screen,
   a. Adjust the *PROBE HOME* value as needed.
      - If probe tip is too low (gap >9.4 mm), increase the *PROBE HOME* value.
      - If probe tip is too high (gap <9.4 mm), decrease the *PROBE HOME* value.

   b. Select the upper *RUN* option and press **ENTER** to rerun the routine.
6. Use the feeler gauge or the 9.4 mm side of the paper to recheck the distance between the tip of the sample probe and the traverse.
   - If the gap is now correct, press **ESC** then proceed to the heading Inside Bath Position Adjustment.
   - If the gap is still incorrect, repeat steps 4 through 6 until the gap is approximately 9.4 mm.

Inside Bath Position Adjustment

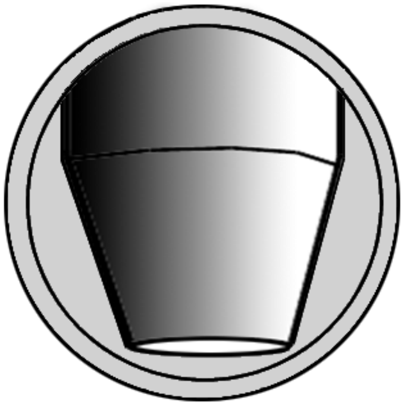
IMPORTANT Do not perform this probe adjustment procedure unless it is absolutely necessary.

---

1. At the Dilution screen, highlight the *RUN CYCLE* option and press **ENTER**.

ATTENTION: As you complete this procedure, it is imperative that as you gaze through the port the circles are centered. When the sample probe is properly adjusted, the tip of the probe should mimic the view shown in Figure 4.6-7.

Figure 4.6-7 Ideal Probe Position



2. The first bath that the probe stops at is the DIL1/HGB bath. Evaluate the position of the probe tip in relation to the bath port.
   - Is it a horizontal positioning problem? Is the probe is too forward (Figure 4.6-8) or too backward (Figure 4.6-9)?

Figure 4.6-8 Improper Probe Tip Position - Too Forward

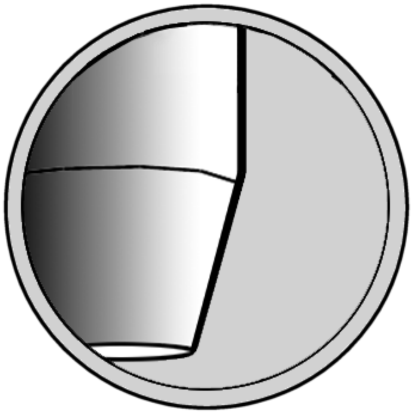
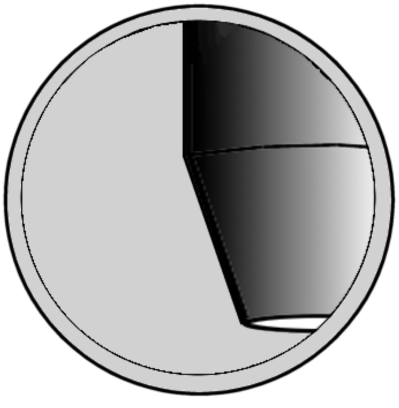


Figure 4.6-9 Improper Probe Tip Position - Too Backward



Note: The *TRAVERSE POS.* value moves the sample probe to the left or right.

   - Is it a vertical positioning problem? Is the probe too high (Figure 4.6-10) or too low (Figure 4.6-11)?

Figure 4.6-10 Improper Probe Tip Position - Too High

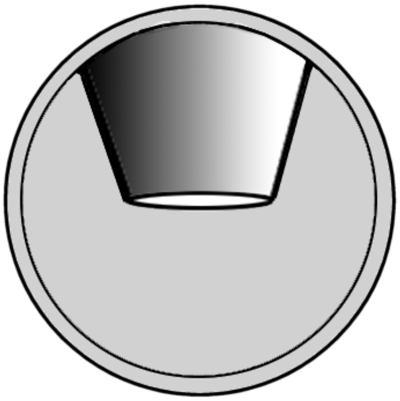
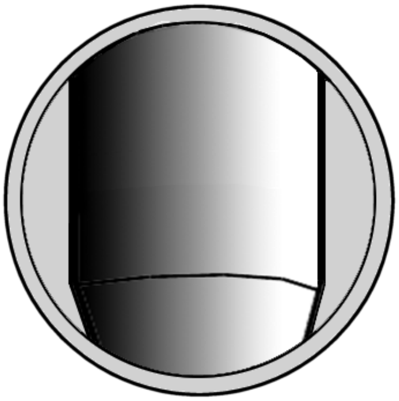


Figure 4.6-11 Improper Probe Tip Position - Too Low



Note: The *PROBE POS*. value moves the sample probe up or down.

3. Determine if changes to the position are required. If they are, press **ENTER** several times to advance through the cycle. At the Dilution screen, adjust the *PROBE POS*. or the *TRAVERSE POS*. values as needed.
   - The *TRAVERSE POS*. value moves the sample probe to the left or right (horizontal positioning).
     - If the probe is too forward (Figure 4.6-8), increase *TRAVERSE POS*. value.
     - If the probe is too backward (Figure 4.6-9), decrease *TRAVERSE POS*. value.
   - The *PROBE POS*. value moves the sample probe up or down (vertical positioning).
     - If the probe is too high (Figure 4.6-10), increase the *PROBE POS*. value.
     - If the probe is too low (Figure 4.6-11), decrease the *PROBE POS*. value.
4. Highlight and **ENTER** the *RUN CYCLE* function again.
5. If the probe position in the DIL1/HGB bath is acceptable, press the **ENTER** key once to advance to the WBC/BASO bath.
6. Check the probe position in the WBC/BASO bath. At this point, there should be no problem with height. If there is, the bath assembly is not level and proceed to the heading BATHS ASSEMBLY ALIGNMENT CHECK AND ADJUSTMENT. When level, start this procedure again at step 1.
   - If the lateral probe position is not correct, adjust the WBC/BASO Traverse Position value. You must press **ENTER** several times and advance through the cycle to make any changes. Increase the number to move the probe farther back, or to the right, decrease to move frontward of to the left. Note that it is rare to change from the default value of 1060.
   - Any changes to this value will almost certainly require changes to the flow cell traverse position and the RBC traverse position, since these are relative moves from the previous bath position.
7. Highlight and **ENTER** the *RUN CYCLE* function again.
8. Advance to the WBC/BASO bath, if not already there, and check the probe position in each bath. If no changes are required, press **ENTER** to advance to the DIFF bath.

9. Check the position in the DIFF bath. The default value is 737 and is usually acceptable. If changes are required, press **ENTER** several times to advance through the cycle. Since the probe was moving back to front, increasing this number moves the probe towards the front or to the left, decreasing the number moves the probe towards the back or to the right. If there were no changes, go to step 11.
10. Highlight and **ENTER** the *RUN CYCLE* function again.
11. Advance to the DIFF bath, if not already there, checking the probe position in each bath. If the positions are acceptable, and no further changes are made, press **ENTER** and advance to the RBC bath.
12. Check the position in the RBC bath. The default value of 734 is usually good. If a change is required, press **ENTER** several times to exit the cycle and adjust the RBC Traverse Position value as required. Highlight and **ENTER** the *RUN CYCLE* function again. Check the probe position in each bath.

WARNING Risk of contamination. If one or more tubings are left unattached to their respective bath ports and you run a cycle, fluid will extrude out the ports onto the exterior of the baths, the counting heads, and valves. It may result in the need for extensive cleanup inside the bath enclosure. To prevent possible biological contamination, you must wear appropriate safety glasses, a lab coat, and gloves.

CAUTION Risk of component damage to electronic components. If one or more tubings are left unattached to their respective bath ports and you run a cycle, fluid will extrude out the ports into the bath enclosure. Excessive moisture may damage the Hgb circuitry and solenoid valves. Thoroughly wipe dry electronic components as quickly as possible.

IMPORTANT Risk of misleading results. If one or more tubings are left unattached to their respective bath ports and you run a cycle, fluid will extrude out the ports onto the exterior of the baths, the counting heads, and valves. Moisture on these components affects parameter results. Thoroughly wipe components dry before reporting patient results.

13. When no changes are required, replace each tubing back on its designated bath port.
14. Perform a system verification. See Heading 5.3, SYSTEM VERIFICATION PROCEDURES.

4.7 HGB BLANK ADJUSTMENT

Purpose

Use this procedure to adjust the Hgb blank voltage. This adjustment must be made under stabilized thermal conditions.

Tools/Supplies Needed

- ☐ Allen wrench, 3 mm
- ☐ Plastic potentiometer adjustment tool, PN 5415364

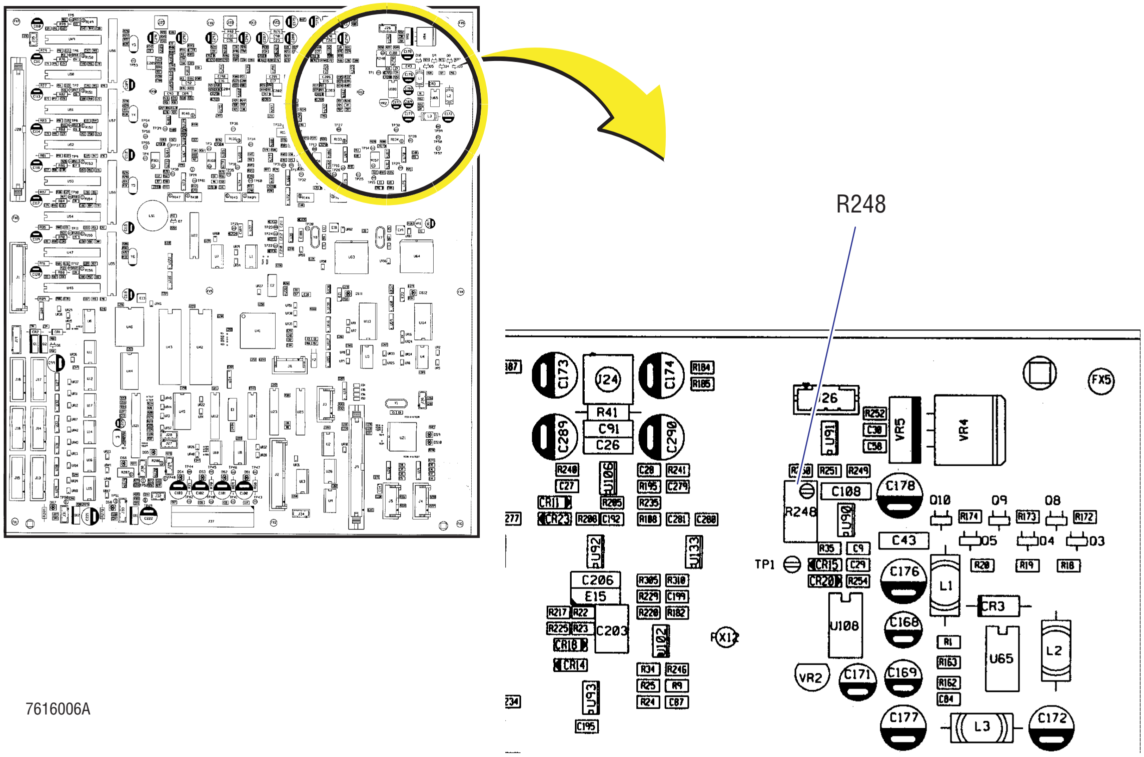
Preparation

IMPORTANT The Hgb blank voltage adjustment must be made under stabilized thermal conditions. Make sure the right side door is closed before starting this adjustment. After completing a Startup, wait at least 5 minutes before performing this adjustment procedure.

---

1. Close the right side door to stabilize the temperature inside the bath enclosure.
2. Remove the left side panel to access the Main card. For details, see Heading 4.2.
3. Locate potentiometer R248 in the upper right quadrant of the Main card (Figure 4.7-1). This is the adjustment potentiometer.

Figure 4.7-1 Main Card Hgb Blank Adjustment


R248
TP1
C108
C178
VR5
VR4
U91
U90
C43
C176
L1
CR3
U108
C168
U65
L2
VR2
C171
C169
C177
L3
C172
FX5
C173
J24
C174
R41
C91
C26
C289
C290
U106
C206
E15
C203
U102
U92
U93
U133
FX12
7616006A

Adjustment

1. From the Service menu, select **2. MEASUREMENT ▸▸ 1. HGB BLANK ADJUSTMENT.**
2. When the HGB BLANK ADJUSTMENT prompt appears, press **ENTER** to continue.

   Note: Selecting this option initiates a routine that drains and rinses the DIL1/HGB bath and continuously displays (for 20 seconds) the Hgb blank voltage used by the converter. Three audible beeps signal the end of the 20 seconds.
3. While monitoring the Hgb Adjustment screen, adjust potentiometer R248 until the voltage reads 4.7 Vdc ±0 Vdc.

Verification

1. Run a Startup and verify the Hgb blank result is acceptable.
2. Run a whole-blood sample to establish a new Hgb reference blank.
3. Replace the left side panel.

4.8 APERTURE CURRENT CHECK

Purpose

Use this procedure to verify the voltages needed to generate aperture current are present and at sufficient levels. These voltages are not adjustable.

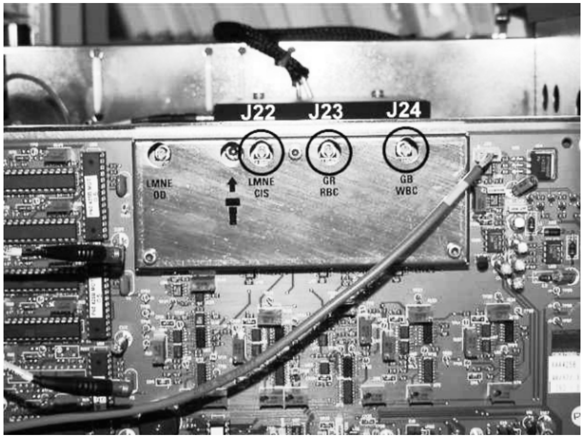
Tools/Supplies Needed

- ☐ Allen wrench, 3 mm
- ☐ Digital voltmeter
- ☐ Old coax

Procedure

1. Open the left side panel to access the Main card. For details, see Heading 4.2.
2. On the Main card, disconnect the LMNE CIS (for DIFF analysis), GR RBC, and GB WBC coaxes (Figure 4.8-1).

Figure 4.8-1 LMNE CIS, GR (RBC), and GB (WBC) Coax Locations



3. From the Service menu, select **2. MEASUREMENT ▸▸ 2. APERTURE CURRENT**.
4. When the Aperture Current prompt appears, press **ENTER**.

CAUTION Do not damage connectors while measuring.

IMPORTANT Use an old coax that you have previously cut to check these voltages with the voltmeter. A flow cell coaxial cable with the T- connector removed is ideal.

---

5. When the *CHECK APERTURE CURRENT* prompt appears, use a DVM to verify the voltages at J22, J23 and J24 (Figure 4.8-1) are approximately 60 Vdc. These voltages are not adjustable.
6. Press **ENTER** to exit the routine.
7. Reconnect the LMNE CIS, GR RBC and GB WBC coaxes (Figure 4.8-1).

ATTENTION: When replacing the left side panel with the instrument powered on, avoid accidently turning the instrument off by carefully positioning the opening for the power on/off rocker switch over the switch as you position the panel on the instrument frame.

8. Replace the left side panel and install the four hex screws that secure it to the instrument frame.

4.9 RBC/PLT GAIN ADJUSTMENT

Purpose

Use this procedure to adjust the RBC and Plt gains. A special cycle automatically makes a 1:220 dilution of the RBC/PLT latex (10 µL of latex to 2.2 mL of diluent). A special count program carries out the calculations of the mean volume in the predefined zones and displays them every 700 ms. The duration of the measurement cycle is 21 seconds.

Tools/Supplies Needed

☐ Allen wrench, 3.0 mm

☐ RBC/PLT latex, PN - LAD002AS

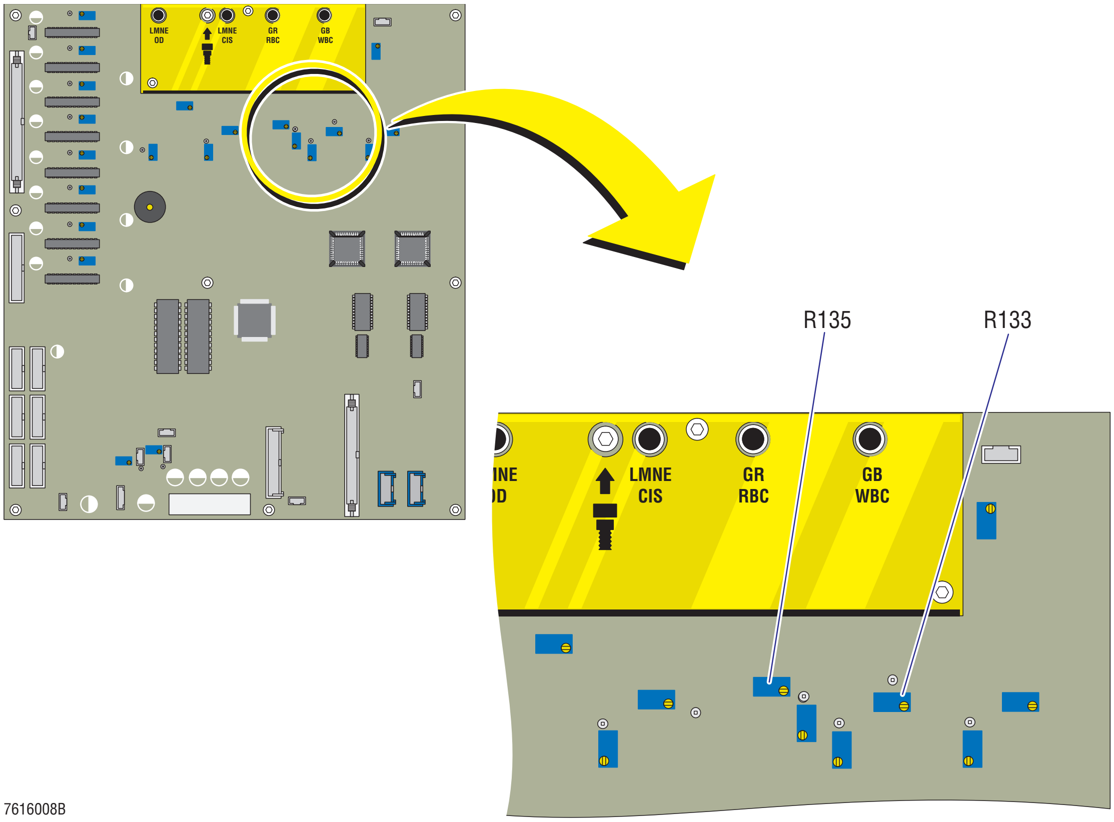
☐ Plastic potentiometer adjustment tool, PN 5415364

Procedure

Preparation

1. Open the left side panel to access the Main card. For details, see Heading 4.2.
2. Locate potentiometers R133 for the RBC adjustment and R135 for the PLT adjustment in the upper right quadrant of the Main card (Figure 4.9-1).

Figure 4.9-1 Main Card RBC/PLT Gain Adjustments



3. From the Service menu, select **2. MEASUREMENT ▸▸ 3. RBC / PLT GAIN.**
4. When the *RBC/PLT GAIN* prompt appears, press **ENTER** to continue.

IMPORTANT Risk of misleading results. The RBC/PLT latex particles tend to clump as they settle out of solution. Clumped latex particles will affect adjustment results. Mix RBC/PLT latex vigorously before use. A vortex may be used. Remix the latex thoroughly before each sampling.

5. Mix the RBC/PLT latex vigorously. Use a vortex, if available.
6. When the *PLEASE SAMPLE LATEX* prompt appears, present the vial of well-mixed latex particles to the probe and press the aspirate switch to initiate aspiration and the routine.

Adjustments

1. While monitoring the RBC bar graph on the RBC/PLT Gain screen, adjust potentiometer R133 to read 78 (target value for RBC).
2. While monitoring the PLT bar graph on the RBC/PLT Gain screen, adjust potentiometer R135 to read 112 (target value for PLT).

4.10 WBC/BASO GAIN ADJUSTMENT

Purpose

Use this procedure to adjust the WBC and BASO gains. A special cycle automatically makes a 1:733 dilution of the RBC/PLT latex (3 µL of latex to 2.2 mL of diluent). A special count program carries out the calculations of the mean volume in the predefined zones and displays them every 700 ms. The duration of the measurement cycle is 21 seconds.

Tools/Supplies Needed

☐ Allen wrench, 3 mm

☐ RBC/PLT latex, PN - LAD002AS

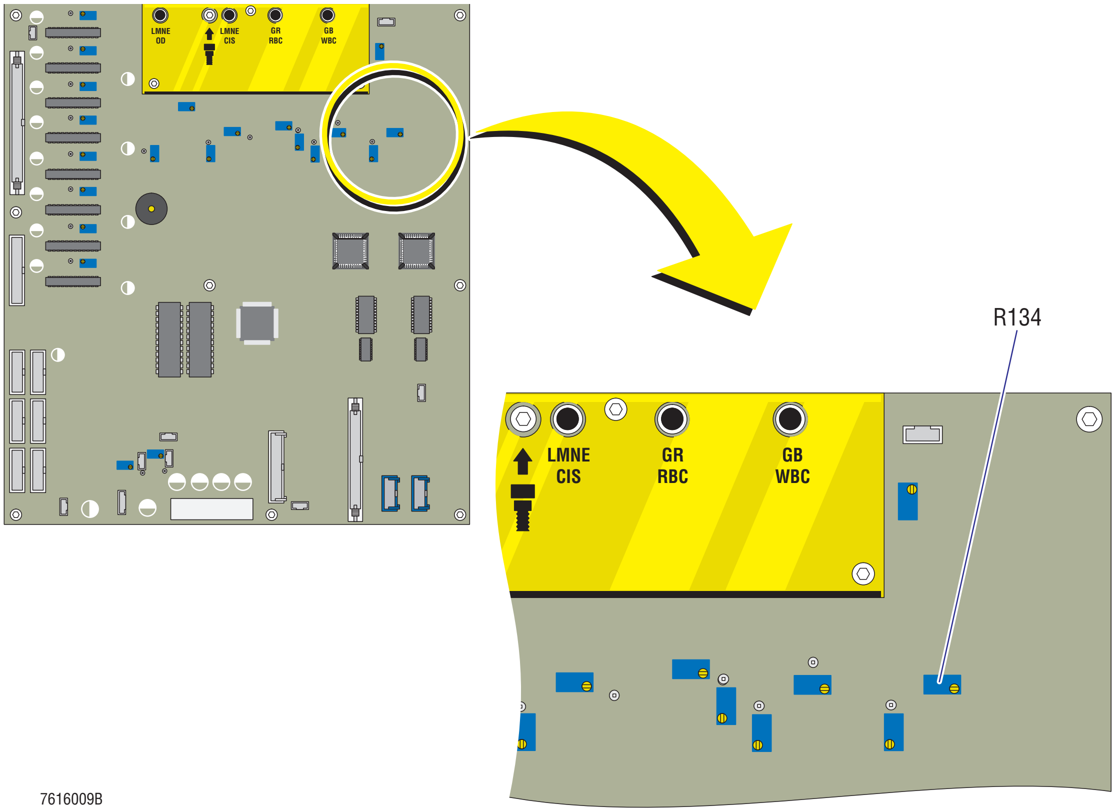
☐ Plastic potentiometer adjustment tool, PN 5415364

Procedure

Preparation

1. Open the left side panel to access the Main card. For details, see Heading 4.2.
2. Locate potentiometer R134 in the upper right quadrant of the Main card (Figure 4.10-1). This is the adjustment potentiometer.

Figure 4.10-1 Main Card WBC/BASO Gain Adjustment



3. From the Service menu, select **2. MEASUREMENT ▸▸ 4. WBC / BASO GAIN.**
4. When the *WBC/BASO GAIN* prompt appears, Press **ENTER** to continue.

IMPORTANT Risk of misleading results. The RBC/PLT latex particles tend to clump as they settle out of solution. Clumped latex particles will affect adjustment results. Mix RBC/PLT latex vigorously before use. A vortex may be used. Remix the latex thoroughly before each sampling.

---

5. Mix the RBC/PLT latex vigorously. Use a vortex, if available.
6. When the *PLEASE SAMPLE LATEX* prompt appears, present the vial of well-mixed latex particles to the probe and press the aspirate switch to initiate aspiration and the routine.

Adjustment

While monitoring the WBC/BASO bar graph on the WBC/BASO Gain screen, adjust potentiometer R134 to read 102 (target value).

4.11 DRAIN SENSOR ADJUSTMENT

Purpose

Use this procedure to adjust the drain sensor. As preparation for this adjustment, this routine automatically empties and fills the drain cell.

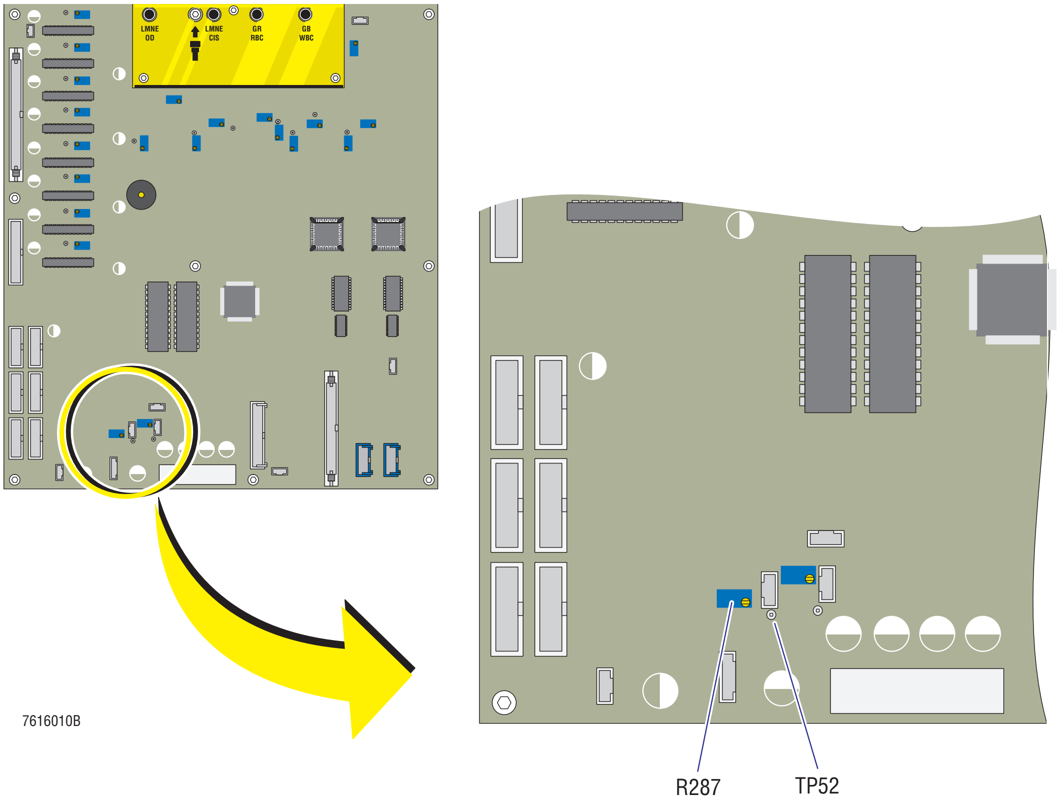
Tools/Supplies Needed

- ☐ Allen wrench, 3 mm
- ☐ Plastic potentiometer adjustment tool, PN 5415364
- ☐ Digital voltmeter (DVM)

Preparation

1. Remove the four hex screws securing the left side panel to the instrument frame. Set the door aside.
2. Locate potentiometer R287 and test point TP52 in the lower left quadrant of the Main card (Figure 4.11-1).

Figure 4.11-1 Main Card Drain Sensor Adjustment



Adjustment

1. From the Service menu, select **5. SENSOR CHECK ▸▸ 1. DRAINING.** The Draining prompt appears on the screen.
2. Press **ENTER** to continue. The *CYCLE IN PROGRESS* bar graph appears and advances to approximately 48% while draining the sensor.
3. When the *ADJUST SENSOR VOLTAGE* prompt appears,
    a. Use a DVM to verify the voltage at TP52 is 4.5 ±0.3.
    b. Adjust the voltage at potentiometer R287 as needed.
    c. Press **ENTER** to continue. The *CYCLE IN PROGRESS* bar graph advances to approximately 53% as the sensor is filled with diluent.
4. When the *CHECK SENSOR VOLTAGE* prompt appears,
    a. Make sure the voltage at TP52 is <1.0 Vdc.
    b. Press **ENTER** to continue. The *CYCLE IN PROGRESS* bar graph advances to 100% as the routine is completed.

Wrap Up

1. Press **ESC** as many times as necessary to return to the Main Menu.
2. Replace the left side panel and install the four hex screws that secure it to the instrument frame.

4.12 TRANSFER SENSOR ADJUSTMENT

Purpose

Use this procedure to adjust the transfer sensor. As preparation for this adjustment, this routine automatically empties then fills the drain sensor. This sensor controls the transfer of the diluted sample from the Diff bath to the flow cell.

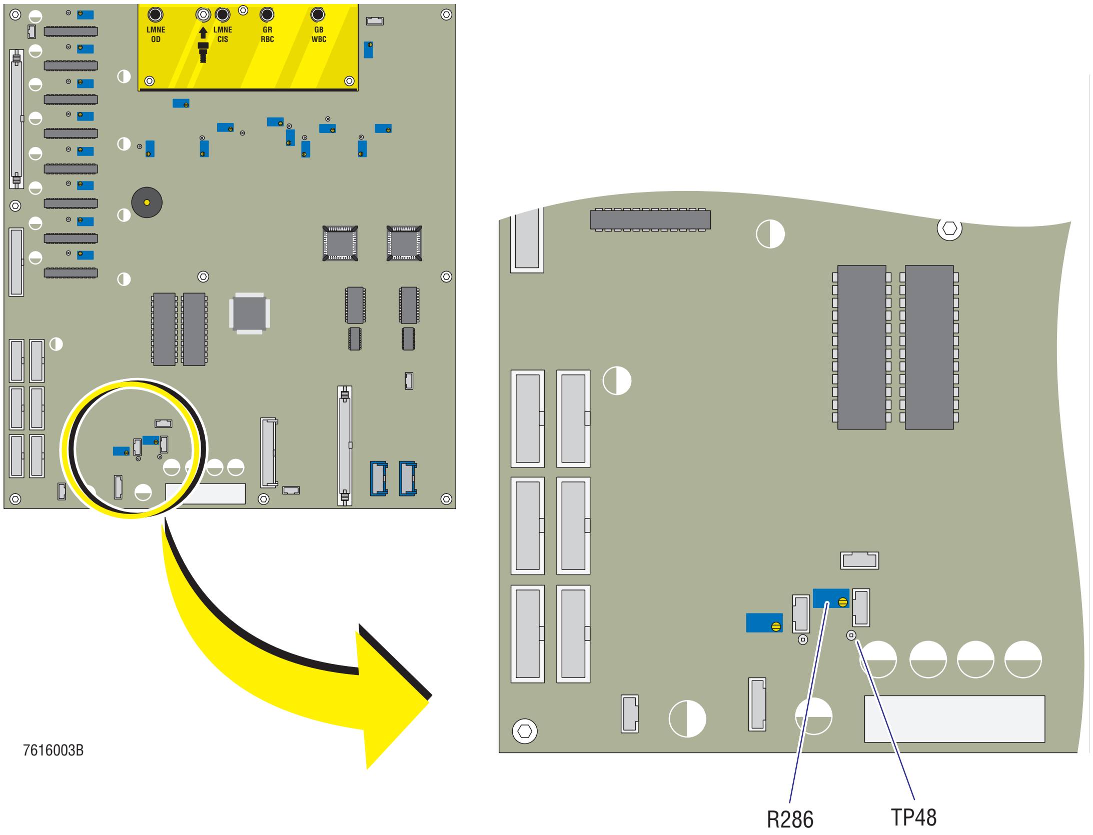
Tools/Supplies Needed

- ☐ Allen wrench, 3 mm
- ☐ Plastic potentiometer adjustment tool, PN 5415364
- ☐ Digital voltmeter (DVM)

Preparation

1. Remove the four hex screws securing the left side panel to the instrument frame. Set the door aside.
2. Locate potentiometer R286 and test point TP48 in the lower left quadrant of the Main card (Figure 4.12-1).

Figure 4.12-1 Main Card Transfer Sensor Adjustment



Adjustment

1. From the Service menu, select **5. SENSOR CHECK ▸▸ 2. DIFF TRANSFER.** The Diff Transfer prompt appears on the screen.
2. Press **ENTER** to continue. The *CYCLE IN PROGRESS* bar graph appears and advances to approximately 48% while draining the sensor.
3. When the *ADJUST SENSOR VOLTAGE* prompt appears,
    a. Use a DVM to verify the voltage at TP48 is 4.5 ±0.3.
    b. Adjust the voltage at potentiometer R286 as needed.
    c. Press **ENTER** to continue. The *CYCLE IN PROGRESS* bar graph advances to approximately 53% as the sensor is filled with diluent.
4. When the *CHECK SENSOR VOLTAGE* prompt appears,
    a. Make sure the voltage at TP48 is <1.0 Vdc.
    b. Press **ENTER** to continue. The *CYCLE IN PROGRESS* bar graph advances to 100% as the routine is completed.

Wrap Up

1. Press **ESC** as many times as necessary to return to the Main Menu.
2. Replace the left side panel and install the four hex screws that secure it to the instrument frame.

4.13 MOTOR CURRENT ADJUSTMENT

Purpose

Use this procedure to check or adjust the voltages for the motors that supply power for the various syringe assemblies and the sampling carriage on the Traverse module.

Tools/Supplies Needed

☐ Allen wrench, 3 mm
☐ Plastic potentiometer adjustment tool, PN 5415364
☐ Digital voltmeter (DVM)

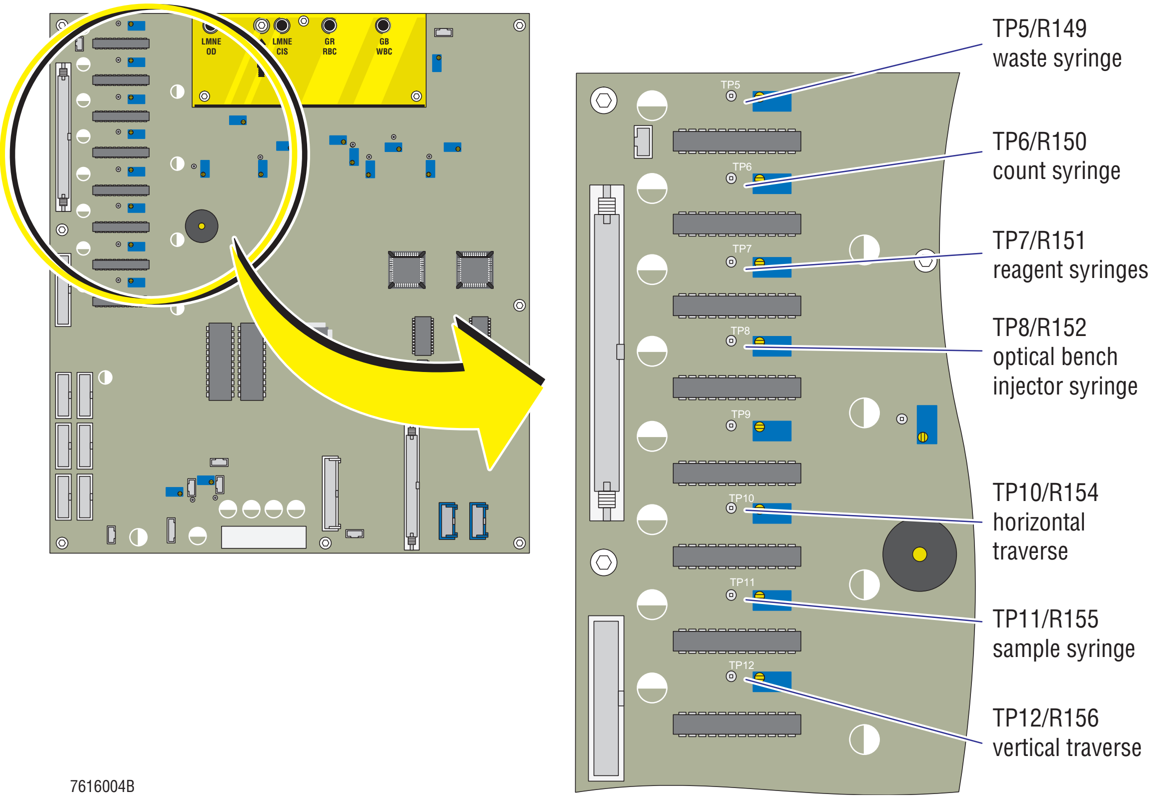
Procedure

1. Open the left side door to access the Main card.
2. Check and adjust, when necessary, the voltages in Table 4.13-1 using the designated potentiometers and test points located in the upper left quadrant of the Main card (Figure 4.13-1).

Table 4.13-1 Motor Voltage Limits

Motors	Test Point	Voltage	Potentiometer
Drain syringe	TP5	4 V ±0.05 V	R149
Count syringe	TP6	4 V ±0.05 V	R150
Reagent syringes	TP7	4 V ±0.05 V	R151
Optical bench injector syringe	TP8	3 V ±0.05 V	R152
Horizontal traverse	TP10	3 V ±0.05 V	R154
Sample syringe	TP11	2 V ± 0.05 V	R155
Vertical traverse	TP12	4.5 V ±0.05 V	R156

Figure 4.13-1 Main Card Motor Current Adjustments


LMNE OD
LMNE CIS
GR RBC
GB WBC
TP5
TP6
TP7
TP8
TP9
TP10
TP11
TP12
TP5/R149 waste syringe
TP6/R150 count syringe
TP7/R151 reagent syringes
TP8/R152 optical bench injector syringe
TP10/R154 horizontal traverse
TP11/R155 sample syringe
TP12/R156 vertical traverse
7616004B

4.14 THRESHOLD ADJUSTMENTS

Purpose

Use this procedure to check or adjust the threshold voltages as needed.

Tools/Supplies Needed

- ☐ Allen wrench, 3 mm
- ☐ Plastic potentiometer adjustment tool, PN 5415364
- ☐ Digital voltmeter

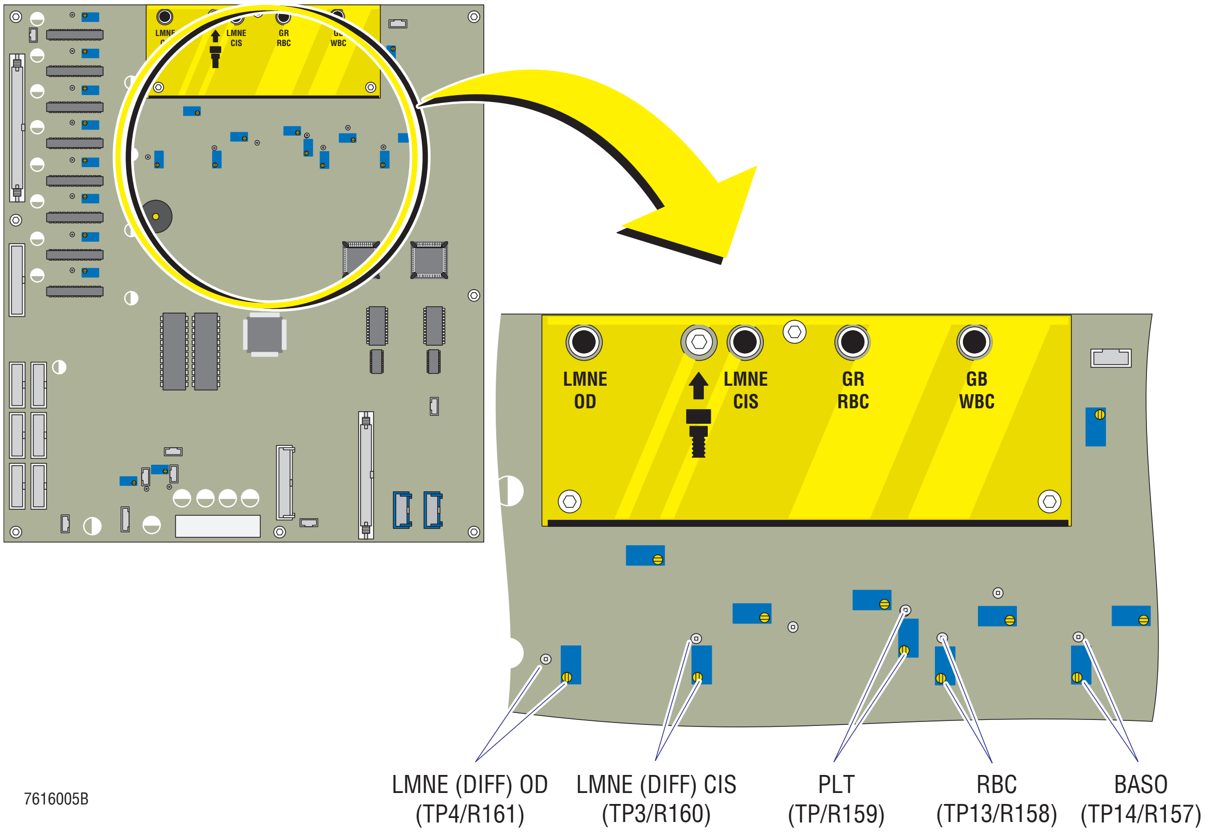
Procedure

1. Open the left side door to access the Main card.
2. Check and adjust, when necessary, the voltages in Table 4.14-1 using the designated potentiometers and test points in the upper area of the Main card (Figure 4.14-1).

Table 4.14-1 Threshold Voltage Limits

Threshold	Test Point	Voltage	Potentiometer
BASO	TP14	300 mV ±5	R157
RBC	TP13	300 mV ±5	R158
PLT	TP2	300 mV ±5	R159
LMNE CIS (for DIFF)	TP3	650 mV ±5	R160
LMNE OD (for DIFF)	TP4	350 mV ±5	R161

Figure 4.14-1 Main Card Threshold Adjustments


LMNE
CIS
GR
RBC
GB
WBC
LMNE
OD
LMNE
CIS
GR
RBC
GB
WBC
LMNE (DIFF) OD
(TP4/R161)
LMNE (DIFF) CIS
(TP3/R160)
PLT
(TP/R159)
RBC
(TP13/R158)
BASO
(TP14/R157)
7616005B

4.15 REAGENT TEMPERATURE CHECK AND ADJUSTMENT

Purpose

Use this procedure to check proper operation of the heating coil and associated system components. This check and adjustment must be made under stabilized thermal conditions.

Tools/Supplies Needed

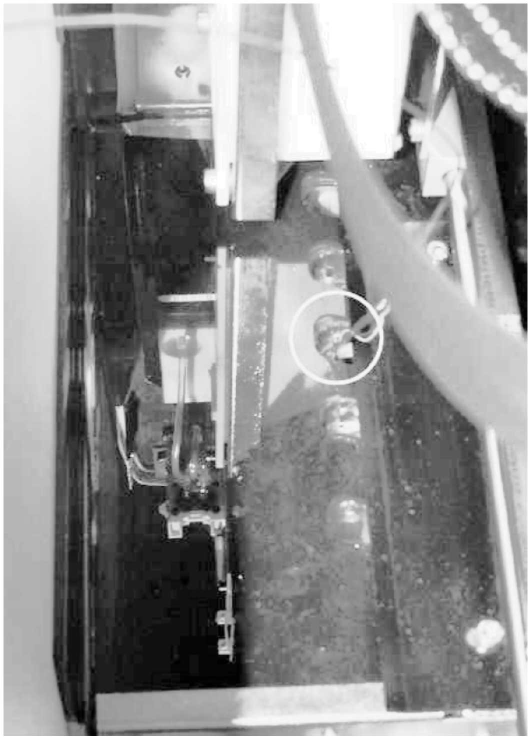
- ☐ Thermometer probe
- ☐ Digital voltmeter

Reagent Temperature Check

1. Open the right side door.
2. Place the thermometer probe into the upper portion of the fluid in the DIFF bath. Avoid touching the sides and bath electrodes (Figure 4.15-1).

   If using a wire bead, bend and insert the bead through the top of the unused fitting of the bath.

Figure 4.15-1 Thermometer Probe inside the DIFF Bath



3. Insert the thermometer probe leads in the DVM.

IMPORTANT The reagent temperature check must be done under stabilized thermal conditions. Make sure the right side door is closed before starting this check. After completing a startup, wait at least 5 minutes before performing this temperature check.

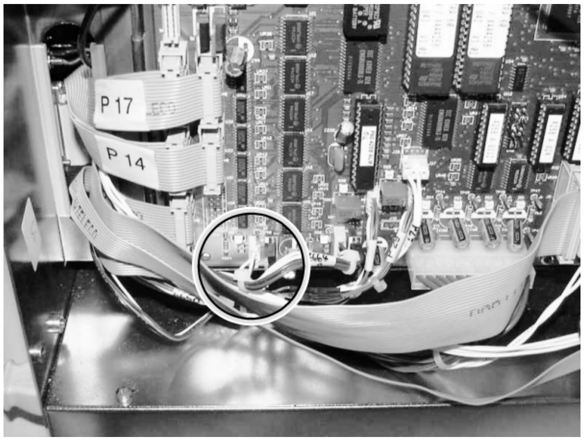
---

4. Carefully close the right side door to ensure the thermometer probe remains submerged in the reagent.
5. Open the left side door.
6. In the lower left quadrant of the Main card, locate the LED near connector J31 (Figure 4.15-2) and verify the LED is flashing (rapidly).

   Note: This LED indicates heating status:

   - When the LED is off, the heating coil is off. When the LED is on, the heating coil is on.
   - A slow blinking LED indicates the heating coil is in the process of increasing or decreasing the temperature.
   - When the LED is flashing rapidly, the heating coil is maintaining the target temperature.

Figure 4.15-2 Main Card Heating Status LED Location



7. From the Service menu, select **3. HEATING SYSTEMS ▸▸ 1. HEATING COIL ▸▸ 2. REFERENCE**.
8. At the Reference screen,
   a. Set the *RUN CYCLE NUMBER* to **5**.

   IMPORTANT Make sure the thermometer probe is submerged in the liquid before starting this routine.

   ---

   b. Select *RUN* then press **ENTER**.
9. Each time the instrument beeps, compare the *REFERENCE TEMPERATURE* with the *RUNNING TEMPERATURE LIMITS* displayed on the screen. Monitor the temperature reading through at least 10 beeps.
   - If the temperature remains within the limits all 10 times, the heating system is working properly. Remove the temperature probe and close the right and left side doors.
   - If the temperature falls outside the displayed limits, perform the Reagent Temperature Adjustment procedure.

Reagent Temperature Adjustment

ATTENTION: Always perform the Reagent Temperature Check before making this adjustment.

Preparation

1. Perform a Reagent Temperature Check if you have not already so.

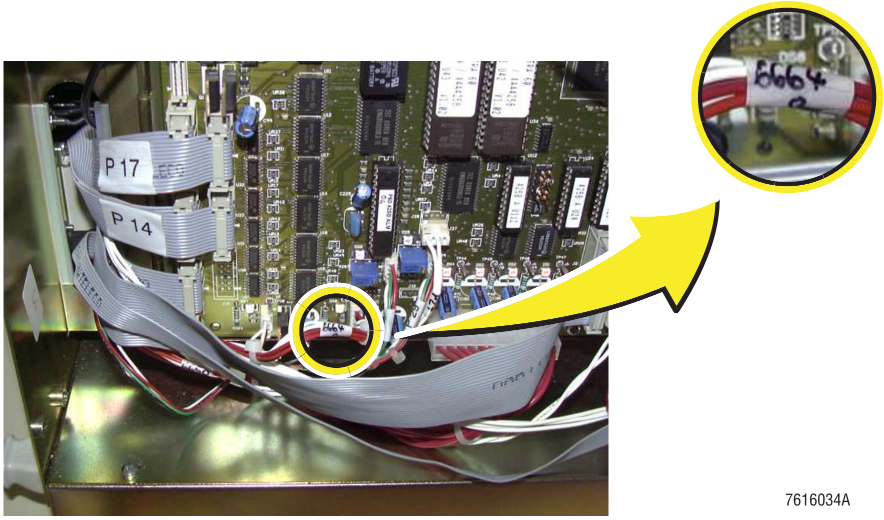
IMPORTANT The reagent temperature adjustment must be done under stabilized thermal conditions. Make sure the right side door is closed before starting this adjustment. After completing a startup, wait at least 5 minutes before performing this temperature adjustment.

---

2. From the Service Menu, select **3. HEATING SYSTEMS ▸▸ 1. HEATING COIL ▸▸ 1.ADJUSTMENT**. The prompt *TEMP. ADJ VALUE XXXX* appears.
3. In the lower left quadrant of the Main card, locate connector J31 and find the temperture value written on the cable (Figure 4.15-3).

   Note: Make sure you read the correct value, the sticker may be oriented up or down.

Figure 4.15-3 Location of the Label Containing the Temperature Value for the Heater Assembly



4. Verify the temperature value on the screen agrees with the temperature value on the cable.
   - If the temperature values agree, press **ESC** to return to Heating Coil menu then proceed to the Adjustment procedure that follows.
   - If the temperature values do not agree, change the screen value to match the value written on the cable, press **ESC** to return to the Heating Coil menu, then continue on to the Adjustment procedure that follows.

Adjustment

1. From the Heating Coil menu, select **2. REFERENCE**.
2. At the Reference screen,
   a. Set the *RUN CYCLE NUMBER* to **5**.

   IMPORTANT Make sure the thermometer probe is submerged in the liquid before starting this routine.

   ---

   b. Select *RUN* then press **ENTER**.
3. Each time the instrument beeps, compare the *REFERENCE TEMPERATURE* with the *RUNNING TEMPERATURE LIMITS* displayed on the screen. Monitor the temperature reading through at least 10 beeps.
   - If the temperature remains within the limits all 10 times, the heating system is working properly. Remove the temperature probe and close the left side door.
   - If the temperature falls outside the displayed limits, go to step 4.
4. Adjust the *TEMPERATURE REFERENCE* value as needed.

   Note: When the temperature reference is increased, the reagent preheating temperature increases; when decreased, the reagent preheating temperature decreases. As the requested temperature change occurs, the heating status LED is blinking slowly.
5. In the lower left quadrant of the Main card, monitor the heating status LED (Figure 4.15-2).
6. When the heating status LED is flashing rapidly (indicating the target temperature is achieved), repeat steps 2 through 5 until you obtain an acceptable temperature. If it is not possible to properly adjust the temperature, change the heating coil using the instructions under Heading 4.19, HEATER ASSEMBLY REPLACEMENT.

4.16 BATH ENCLOSURE TEMPERATURE CHECK AND ADJUSTMENT

Purpose

Use this procedure to check proper operation of the bath enclosure fan and associated system components. These checks and adjustments must be made under stabilized thermal conditions.

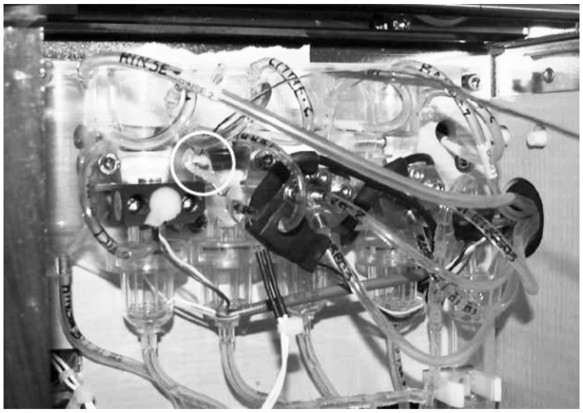
Tools/Supplies Needed

- ☐ Thermometer probe
- ☐ Digital voltmeter

Bath Enclosure Temperature Check

1. Open the right side door.
2. Place the thermometer probe close to the temperature sensor (Figure 4.16-1).

Figure 4.16-1 Temperature Sensor Location - View with the Right Side Door Open



3. Insert the thermometer probe leads in the DVM.

IMPORTANT The bath enclosure temperature check must be done under stabilized thermal conditions. Make sure the right side door is closed before starting this check. After completing a startup, wait at least 5 minutes before performing this temperature check.

---

4. Carefully close the right side door to ensure the thermometer probe remains close to the temperature sensor.
5. From the Service menu, select **3. HEATING SYSTEMS** ▸▸ **2. BATH ENCLOSURE** ▸▸ **2. REFERENCE**.
6. At the Reference screen,
   a. Set the *RUN CYCLE NUMBER* to **5**.

   IMPORTANT Make sure the thermometer probe is close to the temperature sensor before starting this routine.

   b. Select *RUN* then press **ENTER**.

7. Each time the instrument beeps, compare the *REFERENCE TEMPERATURE* with the *RUNNING TEMPERATURE LIMITS* displayed on the screen. Monitor the temperature reading through at least 10 beeps.
   - If the temperature remains within the limits all 10 times, the heating system is working properly. Remove the temperature probe.
   - If the temperature falls outside the displayed limits, perform the Bath Enclosure Temperature Adjustment procedure.

Bath Enclosure Temperature Adjustment

ATTENTION: Always perform the Bath Enclosure Temperature Check before making this adjustment.

Preparation

1. Perform a Bath Enclosure Temperature Check if you have not already so.

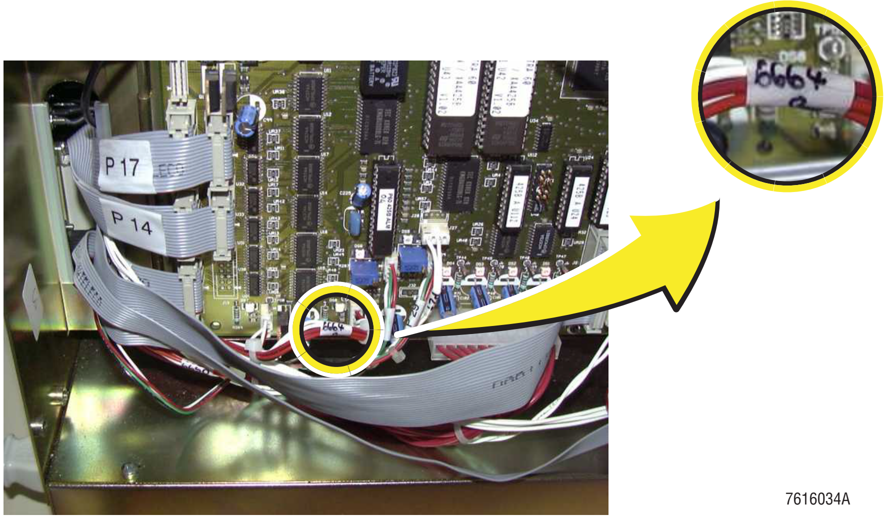
IMPORTANT The bath enclosure temperature adjustment must be done under stabilized thermal conditions. Make sure the right side door is closed before starting this adjustment. After completing a startup, wait at least 5 minutes before performing this temperature adjustment.

---

2. From the Service menu, select **3. HEATING SYSTEMS** ▸▸ **2. BATH ENCLOSURE** ▸▸ **1.ADJUSTMENT**. The prompt *TEMP. ADJ VALUE XXXX* appears.
3. In the lower left quadrant of the Main card, locate connector J33 and find the temperature value written on the cable (Figure 4.16-2).

   Note: Make sure you read the correct value, the sticker may be oriented up or down.

Figure 4.16-2 Location of the Label Containing the Temperature Value for the Temperature Sensor



4. Verify the temperature value on the screen agrees with the temperature value on the cable.
    - If the temperature values agree, press **ESC** to return to Bath Enclosure menu then proceed to the Adjustment procedure that follows.
    - If the temperature values do not agree, change the screen value to match the value written on the cable, press **ESC** to return to the Bath Enclosure menu, then continue on to the Adjustment procedure that follows.

Adjustment

1. From the Bath Enclosure menu, select **2. REFERENCE**.
2. At the Reference screen,
    a. Set the *RUN CYCLE NUMBER* to **5**.

IMPORTANT Make sure the thermometer probe is close to the temperature sensor before starting this routine.

---

    b. Select *RUN* then press **ENTER**.
3. Each time the instrument beeps, compare the *REFERENCE TEMPERATURE* with the *RUNNING TEMPERATURE LIMITS* displayed on the screen. Monitor the temperature reading through at least 10 beeps.
    - If the temperature remains within the limits all 10 times, the bath enclosure temperature monitoring system is working properly. Remove the temperature probe and close the right side door.
    - If the temperature falls outside the displayed limits, go to step 4.
4. Adjust the *REFERENCE TEMPERATURE* value as needed.
    - This adjustment controls the operation of a bath enclosure fan and heater.
    - If the reference temperature is increased, the fan and a heater mechanism inside the fan is turned on until the ambient bath enclosure temperature reaches the desired temperature.
    - If the reference temperature is decreased, the fan is turned on to pull atmospheric air into the bath enclosure until the ambient temperature inside the enclosure reaches the desired temperature.
    - If it is not possible to properly adjust the temperature, check fan operation.

4.17 VACUUM CHECKS AND ADJUSTMENTS

Purpose

Use this procedure to check waste or count syringe vacuum and to adjust the count syringe vacuum, as needed. Since altitude affects vacuum, these vacuum checks should be performed anytime an instrument is being installed in a location that is either above or below sea level.

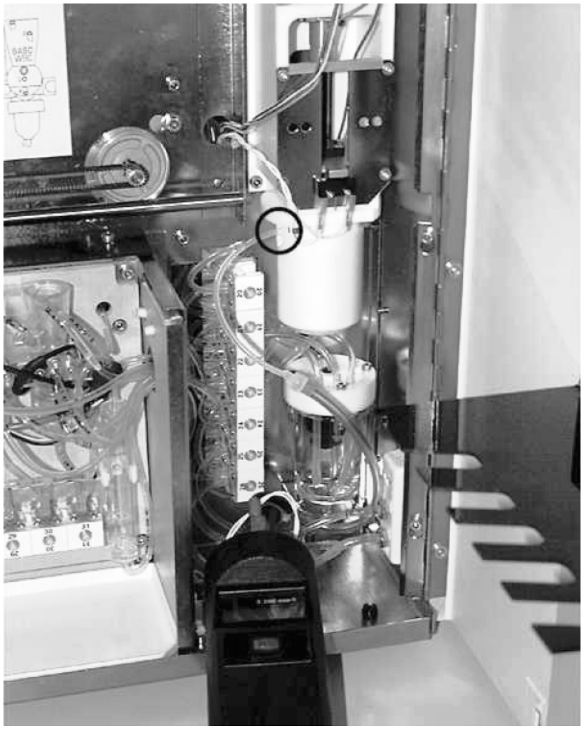
Tools/Supplies Needed

☐ External digital pressure/vacuum gauge; hereafter, referred to as a vacuum meter.

Waste Syringe Vacuum Check

1. Open the right side door.
2. Remove the tubing attached to the side of the waste syringe and replace it with a tubing attached to the vacuum meter, as shown in Figure 4.17-1.

Figure 4.17-1 Attach the Vacuum Meter to the Waste Syringe



IMPORTANT Risk of misleading results. The syringe creates a finite vacuum. It does not have continuous flow and evacuation like a pump. If the tubing attached to the vacuum meter is too large, the volume of the tubing adds to the volume in the syringe and may produce falsely low readings.

3. From the Service menu, select **6. VACUUM CHECK ▸▸ 2. DRAINING**.
4. When the *CHECK VACUUM* prompt appears on the screen, check the vacuum reading on the vacuum meter. The vacuum must be approximately 260 mb (7.7-inches Hg) and must be stable.

   Note: No vacuum adjustment is available for the waste syringe.

5. Disconnect the vacuum meter and reattach the tubing on the waste syringe.
6. Close the right side door.

Count Syringe Vacuum Check and Adjustment

Count Syringe Vacuum Check

1. Remove the left side panel. For details, see Heading 4.2.

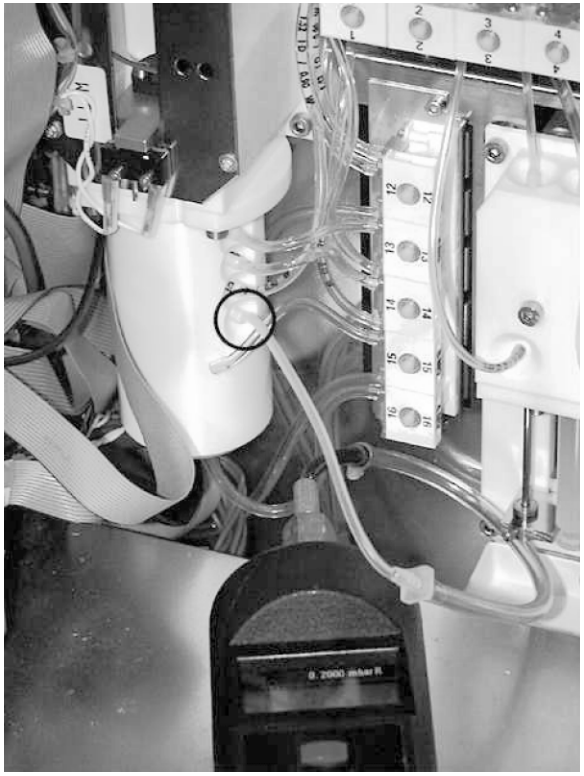
CAUTION A flat cable is connected to the rear of the Main card. Be careful when you open the door (where the Main card is attached) that you do not disconnect or damage this cable.

2. In the left side compartment,
   a. Turn the two captive knobs counterclockwise to release the Main card door. These knobs are located to the right of the Main card.
   b. Open the Main card door and carefully anchor the door behind the white plastic catch to keep it open. The optical bench is exposed.

IMPORTANT Risk of misleading results. The syringe creates a finite vacuum. It does not have continuous flow and evacuation like a pump. If the tubing attached to the vacuum meter is too large, the volume of the tubing adds to the volume in the syringe and may produce falsely low readings.

3. At the count syringe, disconnect the side tubing nearest the bottom of the syringe and replace it with a tubing attached to the vacuum meter, as shown in Figure 4.17-2.

Figure 4.17-2 Attach the Vacuum Meter to the Count Syringe



4. From the Service menu, select **6. VACUUM CHECK ▸▸ 1. COUNTING**.
5. When *VACUUM XXX* prompt appears on the screen, the down arrow key select the *RUN* prompt.
6. When the *CHECK VACUUM (XXX MB)* prompt appears, check the vacuum reading on the vacuum meter. The vacuum must be approximately 220 mb (6.5-inches Hg) and stable.
   - If the vacuum level is correct and stable, go to step 7.
   - If the vacuum level is too low or unstable, press **ESC** to erase the *CHECK VACUUM (XXX MB)* prompt then go to the Count Syringe Vacuum Adjustment heading to make the appropriate adjustment.
7. Disconnect the vacuum meter and reattach the tubing on the count syringe.
8. Close the Main card door. Turn the two captive knobs clockwise to secure the door.

ATTENTION: When replacing the left side panel with the instrument powered on, avoid accidently turning the instrument off by carefully positioning the opening for the power on/off rocker switch over the switch as you position the panel on the instrument frame.

9. Replace the left side panel and install the four hex screws that secure it to the instrument frame.
10. Press **ESC** as many times as necessary to return to the Main Menu.
11. Continue operation.

Count Syringe Vacuum Adjustment

1. At the Counting screen, use the up arrow to move the cursor to the *VACUUM XXX* prompt then change the step value for vacuum.
   - If the vacuum is too low, increase the step value.
   - If the vacuum is too high, decrease the step value.
2. Select the *RUN* prompt.
3. When the prompt *CHECK VACUUM (XXX MB)* appears, check the vacuum reading on the vacuum meter. The vacuum must be approximately 220 mb (6.5-inches Hg) and stable.
   - If the vacuum level is correct and stable, go to step 4.
   - If the vacuum level is still unacceptable, press **ESC** and repeat steps 1 through 3 until the vacuum is stable at approximately 220 mb (6.5-inches Hg).
4. Disconnect the vacuum meter and reattach the tubing on the count syringe.
5. Close the Main card door. Turn the two captive knobs clockwise to secure the door.

ATTENTION: When replacing the left side panel with the instrument powered on, avoid accidently turning the instrument off by carefully positioning the opening for the power on/off rocker switch over the switch as you position the panel on the instrument frame.

6. Replace the left side panel and install the four hex screws that secure it to the instrument frame.
7. Press **ESC** as many times as necessary to return to the Main Menu.
8. Continue operation.

4.18 MIX BUBBLE ADJUSTMENT

Purpose

Mixing bubbles are factory adjusted and normally do not require further adjustments; however, if an adjustment is necessary follow this procedure.

Tools/Supplies Required

☐ None

Procedure

1. From the Service menu, select **4. MIXING**.
2. At the Mixing screen, enter a new step value to increase or decrease the mixing, as needed. Use the values in Table 4.18-1 as a guide.
    - To increase bubbling, increase the number of steps.
    - To decrease bubbling, decrease the number of steps.

Table 4.18-1 Mixing Bubble Limits

Mixing Bath	Low Limit	Normal	High Limit
FIRST DILUTION	100	300	400
DIFF	100	300	400
WBC/BASO	100	300	400
HGB LYSE	300	400	500

3. Verify the final step values are within limits (Table 4.18-1).

4.19 HEATER ASSEMBLY REPLACEMENT

Purpose

Use this procedure to replace the heater assembly.

Tools/Supplies Needed

- ☐ Allen wrench, 3 mm
- ☐ Flat-blade screwdriver
- ☐ Torx keys
- ☐ Heater reagent coil assembly, PN - XDA625AS

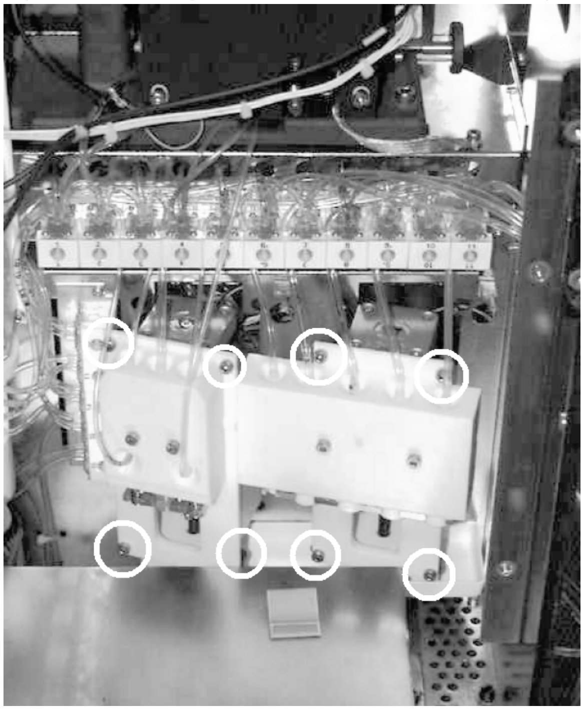
Removal

1. To access the heater assembly:
   a. Remove the front panel. Follow cover removal under Heading 4.2.
   b. Pull the reagent syringes and the 5 diff syringe to free space behind (no need to disconnect tubes).

   ATTENTION: The syringe assemblies uses captive hex screws mounted inside rubber shock mounts. It is recommended that you use only four turns to either loosen or tighten these screws. Turning the hex screw too many counterclockwise rotations may separate the screw from the rubber shock mount. If all Service Representatives consistently use four turns to remove or install these hex screws, it is unlikely that a rubber shock mount will separate from its hex screw and fall inside the instrument.

   c. Locate the six hex screws (CHC M4x16) shown in Figure 4.19-1. These are captive screws anchored inside rubber shock mounts.

Figure 4.19-1 Captive Hex Screw Locations - Reagent Syringes and 5diff Syringe

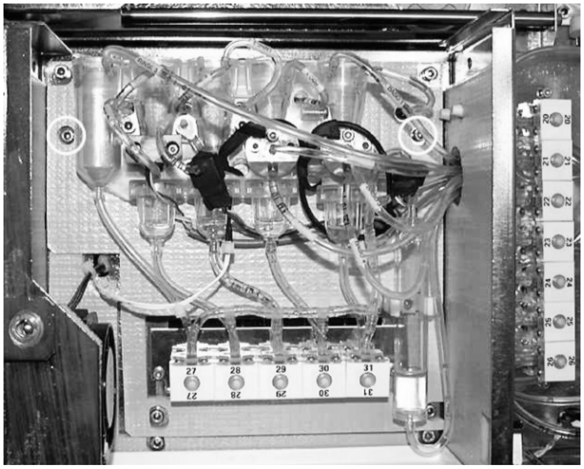


   d. Loosen each hex screw with four counterclockwise rotations.

   Note: If a screw is not released in four rotations, the screw was overtightened the last time the syringe assembly was serviced. From this point, make a single rotation then check to see if the mount is free. Repeat this sequence of making a single rotation and checking until the mount is free.

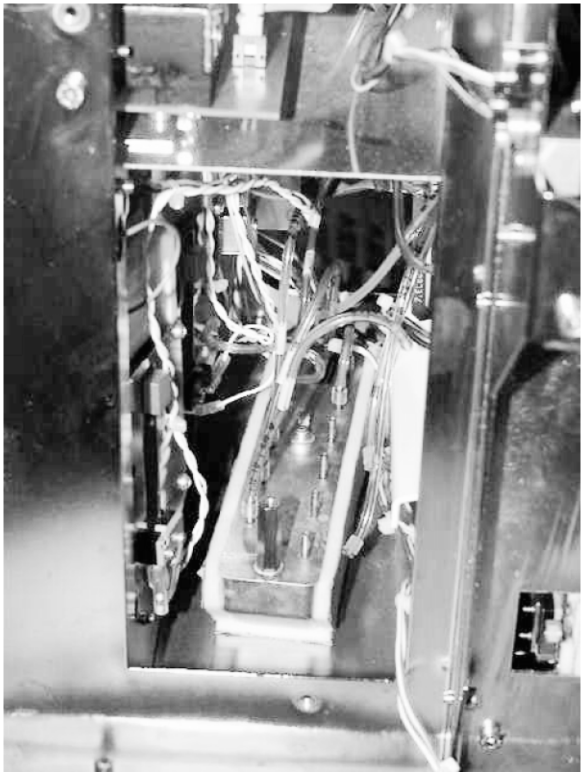
2. Open the right side door.
3. Disconnect the following tubings:
   - At the WBC/BASO bath, disconnect the tubing attached to port 2.
   - At the RBC bath, disconnect the tubing attached to port 1.
   - At the DIFF bath, disconnect the tubing attached to ports 2 and 3.
   - At the DIL1/HGB bath, disconnect the tubing attached to port 1.
4. Unscrew the two CHC M3x6 screws shown in Figure 4.19-2.

Figure 4.19-2 CHC M3 x 6 Screw Locations



5. The heater assembly is free. Lay the assembly on the instrument frame (Figure 4.19-3).

Figure 4.19-3 Heater Assembly

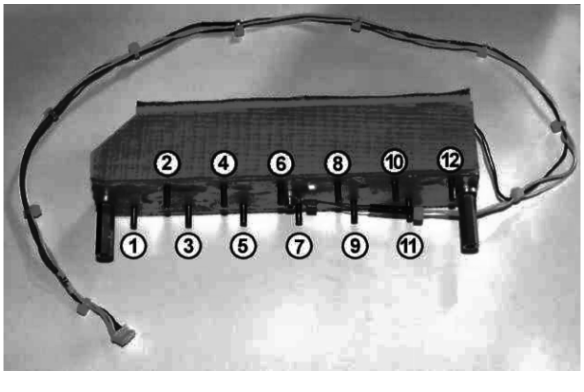


6. Move the heater assembly as close as possible to the opening in the instrument's frame.
7. Using Figure 4.19-4 as a guide, disconnect the tubings attached to ports 1, 3, 5, 7, and 10 on the heater assembly.

   Note: The ports are associated with the following components:

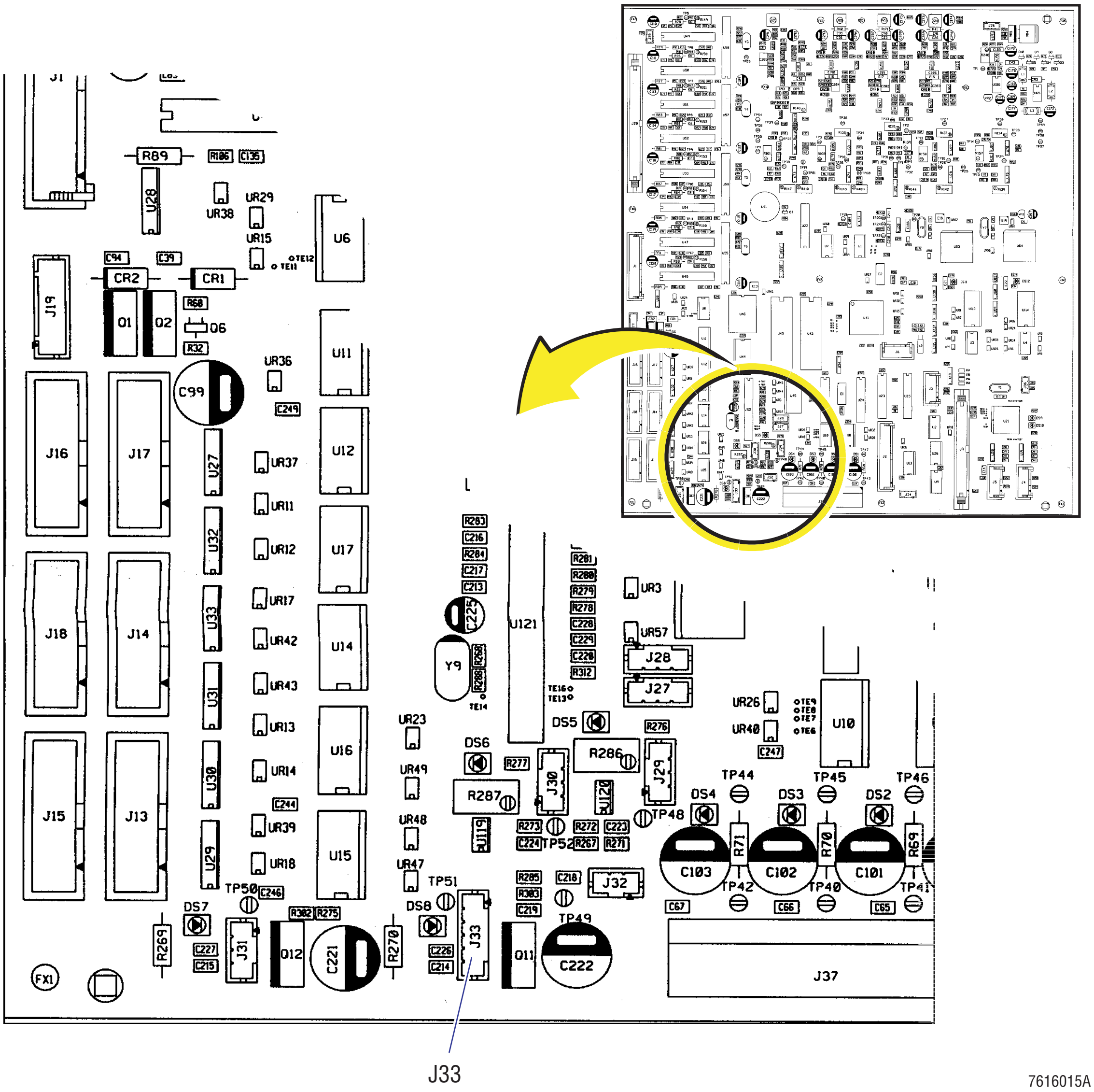
   - The tubing disconnected from port 1 is from valve 22, port 2.
   - The tubing disconnected from port 3 is from valve 8, port 2.
   - The tubing disconnected from port 5 is from T4.
   - The tubing disconnected from port 7 is from valve 22, port 1.
   - The tubing disconnected from port 10 is from valve 11, port 2.

Figure 4.19-4 Heater Assembly - Tubing Port Locations



8. Locate connector P33 in the lower left quadrant of the Main card (Figure 4.19-5).

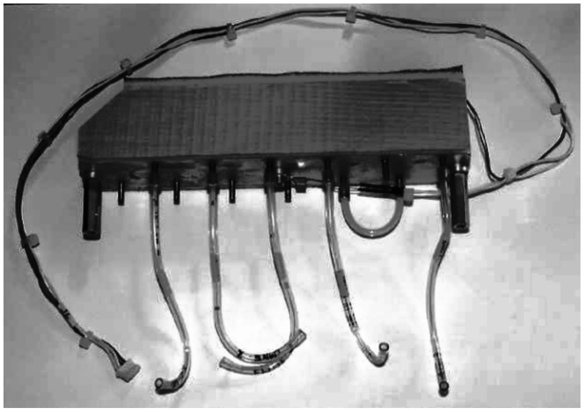
Figure 4.19-5 Main Card Heater Assembly Replacement



9. Remove the heater assembly cable attached to J33.

10. Pull the disconnected cable (and tubings) through the instrument and remove the heater assembly (Figure 4.19-6).

Figure 4.19-6 Heater Assembly After Removal

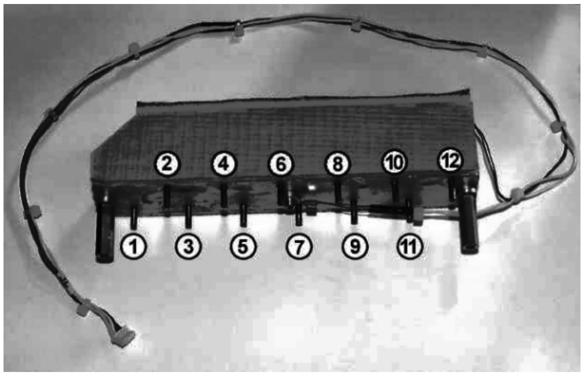


11. Place the heater assembly on a stack of absorbent paper towels to drain it.

Installation

1. Place the new heater assembly next to the old heater assembly. Make sure they are oriented in the same direction (cables on the same side, ports facing the same direction).
2. One by one, disconnect a tubing from the old heater and attach it in the same location on the new heater. Use Figure 4.19-7 as a guide if needed.

Figure 4.19-7 Heater Assembly - Tubing Port Locations

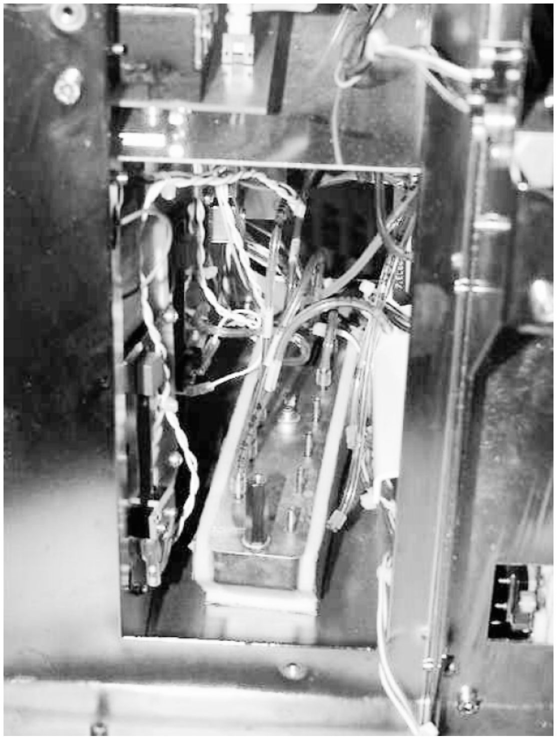


Note: The tubings being removed from the ports on the old heater and attached to the ports on new heater are associated with the following components:

- The tubing attached to port 2 will later be attached to the diluent bath, DIL1/HGB.
- The tubing attached to port 4 will later be attached to the DIFF bath, DIFF 3.
- The tubing attached to port 6 will later be attached to the DIFF bath, DIFF 2.
- The tubing attached to port 8 will later be attached to the RBC bath, RBC 1.
- The tubing attached to port 9 loops to port 11 on the heater assembly.
- The tubing attached to port 12 will later be attached to the WBC/BASO bath, WBC/BASO 2.

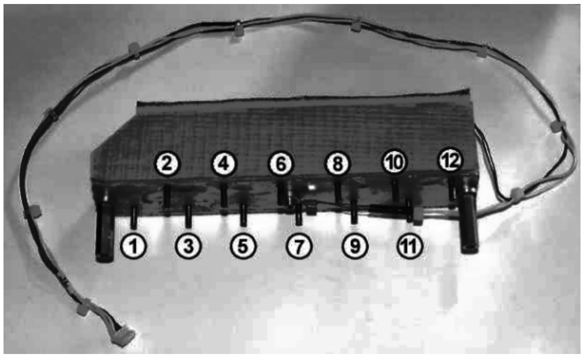
3. Discard the old heater assembly.
4. Position the new heater assembly (with the old tubing attached) inside the instrument frame (Figure 4.19-8).

Figure 4.19-8 Heater Assembly - Orientation Inside the Instrument



5. Using Figure 4.19-9 as a guide, one by one, locate each tubing removed from the old heater assembly and attach the tubing to its designated port on the new heater assembly:
   a. Locate the tubing attached to valve 11, port 2. Attach this tubing to port 10 of the heater assembly.
   b. Locate the tubing attached to valve 22, port 1. Attach this tubing to port 7 of the heater assembly.
   c. Locate the tubing attached to T4. Attach this tubing to port 5 of the heater assembly.
   d. Locate the tubing attached to valve 8, port 2. Attach this tubing to port 3 of the heater assembly.

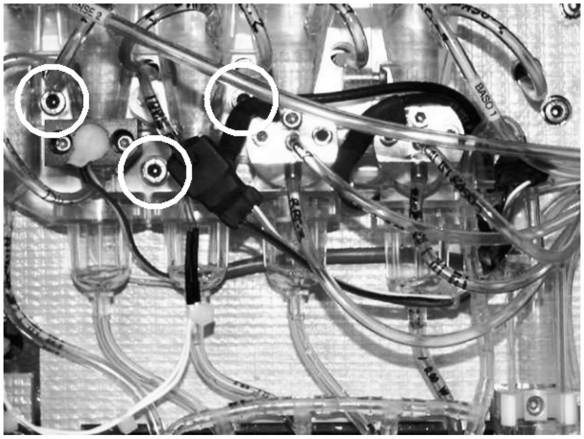
Figure 4.19-9 Heater Assembly - Port Locations



   e. Locate the tubing attached to valve 22, port 2. Attach this tubing to port 1 of the heater assembly.

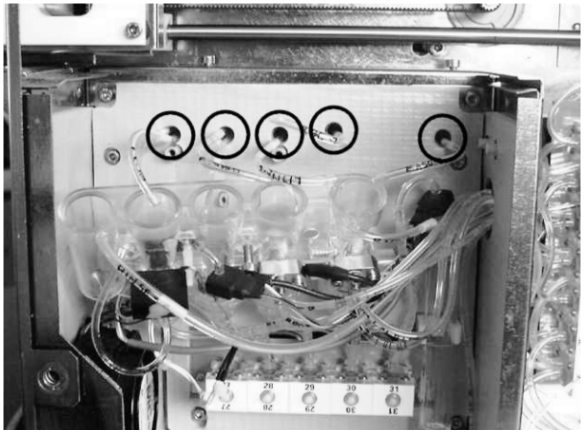
6. Remove the three nuts shown in Figure 4.19-10. Removing these nuts dismantles the bath assembly from the instrument frame so that tubings attached to the new heater assembly can be routed through the panel openings for attachment to the designated bath.

Figure 4.19-10 Baths Assembly Support Panel Nut Locations



7. Lift and position the heater assembly so that each tubing disconnected during the removal procedure can be routed through the support panel opening closest to the bath where the tubing must be attached (Figure 4.19-11).

Figure 4.19-11 Location of Openings in the Baths Assembly Support Panel

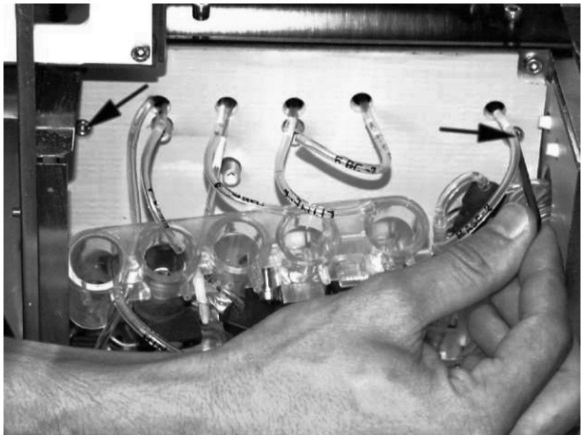


8. From left to right, locate the tubing on the heater assembly and route the tubing through the panel opening closest to the bath:
   - Route the tubing attached to heater assembly port 2 through the first opening for attachment to the DIL1/HGB bath.
   - Route the tubing attached to heater assembly port 4 through the second opening for attachment to the DIFF bath, DIFF 3.
   - Route the tubing attached to heater assembly port 6 through the third opening for attachment to the DIFF bath, DIFF 2.

- Route the tubing attached to heater assembly port 8 through the fourth opening for attachment to the RBC bath, RBC 1.
- Route the tubing attached to heater assembly port 12 through the fifth opening for attachment to the BASO bath, BASO 2.

9. Secure the two heater assembly screws (Figure 4.19-12).

Figure 4.19-12 Heater Assembly Screw Locations



10. At the Main card, reconnect the cable attached to the heater assembly to connector J33 (Figure 4.19-5).
11. Secure the reagent syringes and the 5diff syringe back inside the instrument:
    a. Locate the six captive hex screws (Figure 4.19-1). The syringe assemblies should be flush against the instrument frame.

    ATTENTION: It is recommended that you use only four clockwise turns to tighten these captive hex screws. As each hex screw is tightened, its rubber shock mount expands to secure the syringe assembly to the instrument frame. If all Service Representatives consistently use four turns to install these hex screws, it is unlikely that a rubber shock mount will separate from its hex screw and fall inside the instrument the next time the assembly is removed.

    b. Tighten the six hex screws using four clockwise rotations.
12. Replace the front panel. Follow Heading 4.2, OPENING OR REMOVING INSTRUMENT DOORS, PANELS, AND COVERS.
13. Do a probe to bath alignment check. Go to Heading 4.5, BATHS ASSEMBLY ALIGNMENT CHECK AND ADJUSTMENT.
14. When startup and prime cycles are done, verify there are no leaks.

4.20 POWER SUPPLY REPLACEMENT

Purpose

Use this procedure to remove and replace the power supply as needed.

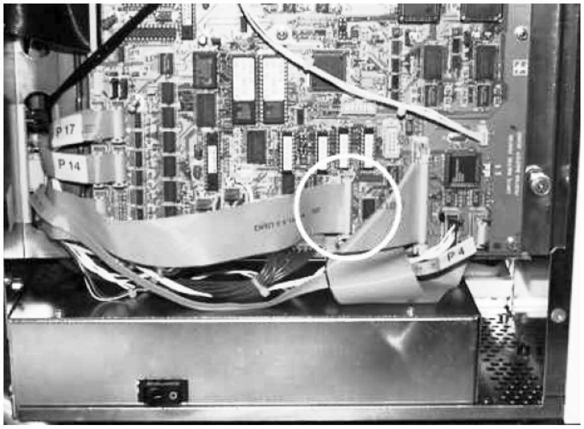
Tools/Supplies Needed

- ☐ Allen wrench, 3 mm
- ☐ Flat-blade screwdriver
- ☐ Power Supply, PN 1xDBN 004 A

Removal

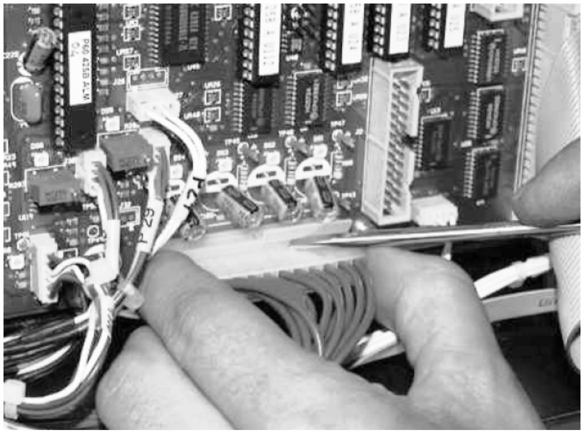
1. Turn the instrument off and disconnect the power cord.
2. Open the cover.
3. Open the left side door.
4. At the bottom of the Main card,
    a. Disconnect the printer RS flat cable attached to connector J2 (Figure 4.20-1).

Figure 4.20-1 Main Card - J2 Location



    b. With a flat-blade screwdriver, disconnect the power supply cable attached to connector J37 (Figure 4.20-2).

Figure 4.20-2 Main Card - J37 Location



CAUTION A flat cable is connected to the rear of the Main card. Be careful when you open the door (where the Main card is attached) that you do not disconnect or damage this cable.

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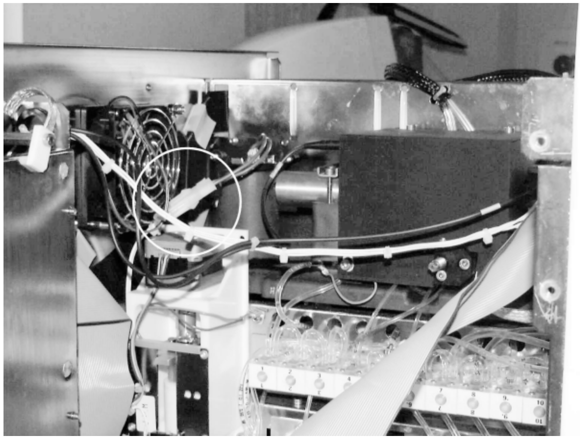
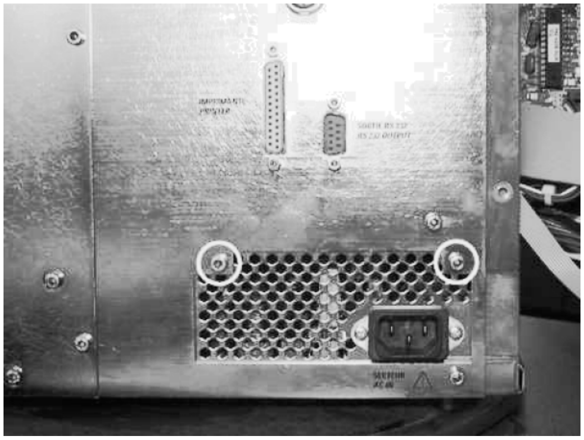
5. Open the Main card door (block it open).
6. Disconnect the optical bench lamp supply cable (Figure 4.20-3).

Figure 4.20-3 Optical Module - Lamp Supply Cable Location



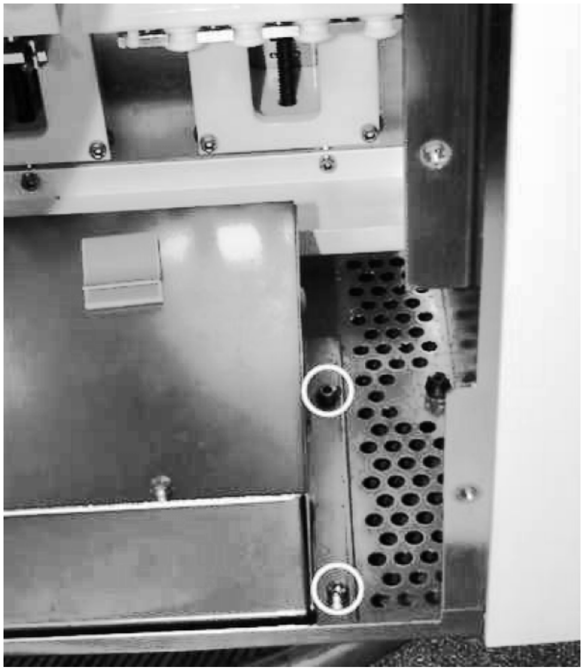
7. At the rear panel of the instrument, remove the two CHC M3x6 screws securing the power supply to the rear panel (Figure 4.20-4).

Figure 4.20-4 Location of Screws Securing the Power Supply to the Rear Panel



8. Remove the rear panel and set it aside.
9. Remove the two CHC M3x6 front screws securing the power supply to the instrument frame (Figure 4.20-5).

Figure 4.20-5 Screws Securing the Power Supply to the Instrument Frame



CAUTION Make sure the lamp power supply cable is disconnected before removing the power supply.

---

10. Remove the power supply.

Installation

1. Position the new power supply inside the instrument.
2. Secure the power supply to the instrument frame using the two CHC M3x6 front screws removed earlier (Figure 4.20-5).

3. Make sure the lamp supply cable is routed towards the optical bench then replace the rear panel.
4. Secure the power supply to the rear panel using the two CHC M3x6 screws removed earlier (Figure 4.20-4).
5. Connect the optical bench lamp supply cable (Figure 4.20-3).
6. Close the Main card door.
7. At the bottom of the Main card,
    a. Connect the power supply cable to connector J37 (Figure 4.20-2).
    b. Connect the printer RS flat cable to connector J2 (Figure 4.20-1).
8. Insert the power supply connector into the socket on the rear instrument panel. Make sure the plug end is in the wall socket.
9. Turn the instrument on.
10. Replace the left side panel.

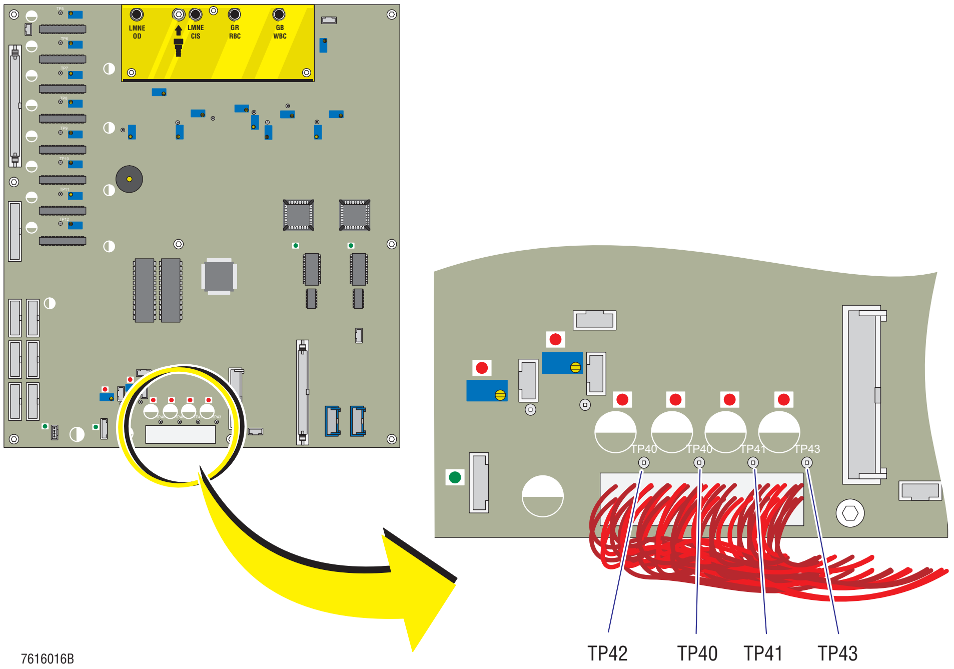
Verification

At the Main card, check following voltages (Figure 4.20-6):

Table 4.20-1 Power Supply Voltages

Test Point	Designation	Target Voltage
TP40	5V Power supply	+5 V
TP41	12V Power supply	+12 V
TP42	24V Power supply	+24 V
TP43	-12V Power supply	-12 V

Figure 4.20-6 Main Card Heater Assembly Replacement Adjustment



4.21 START SWITCH REPLACEMENT

Purpose

Use this procedure to remove then replace the Start switch anytime it needs to be changed or dismantled.

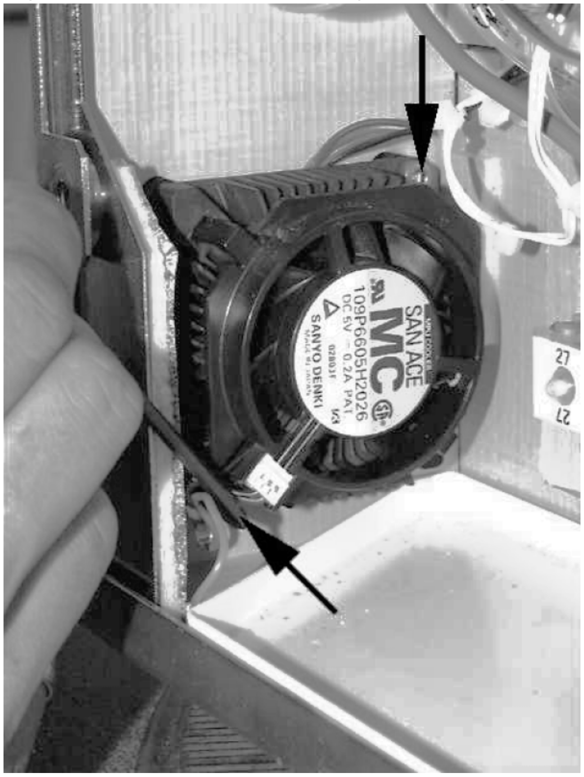
Tools/Supplies Needed

- ☐ Allen wrenches
- ☐ Torx keys
- ☐ Flat-blade screwdriver

Removal

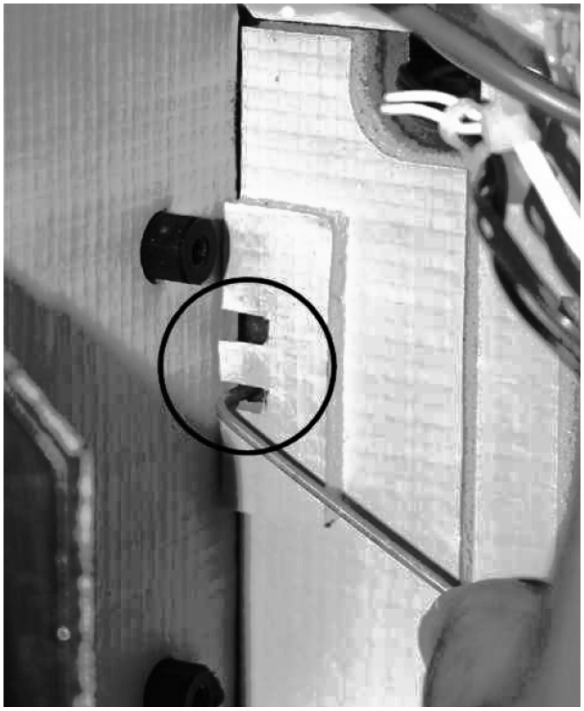
1. To access the start switch, remove the front panel. See Heading 4.2, OPENING OR REMOVING INSTRUMENT DOORS, PANELS, AND COVERS, if needed.
2. Open the pneumatic access door (right side of the instrument).
3. Remove the enclosure fan that contains a thermostat (Figure 4.21-1).
    a. Using a flat-blade screwdriver, remove the ground from the fan assembly.
    b. Remove the four screws securing the fan to the front panel.

Figure 4.21-1 Fan Removal - Right Side Compartment



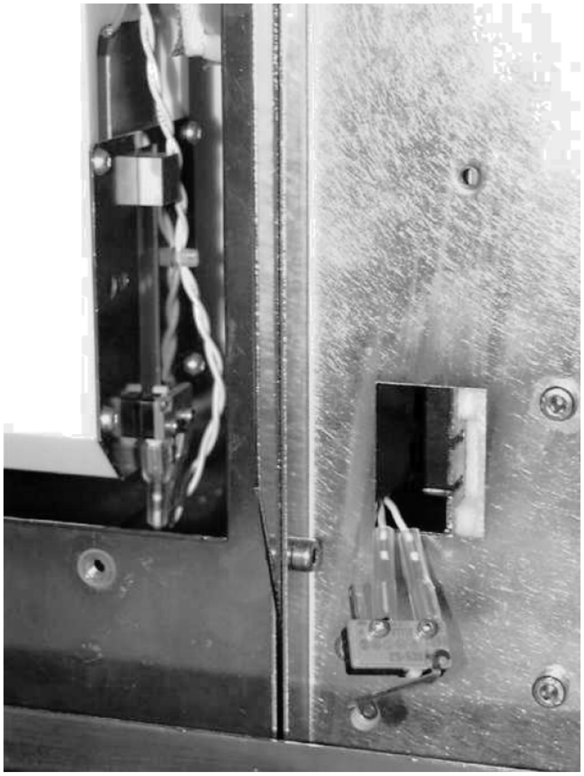
4. Remove the two screws securing the start switch to the instrument's frame (Figure 4.21-2).

Figure 4.21-2 Start Switch Screw Locations - With Fan Removed



5. Disconnect the start switch (Figure 4.21-3).

Figure 4.21-3 Disconnected Start Switch - Front View with Front Panel Removed



6. Remove the start switch.

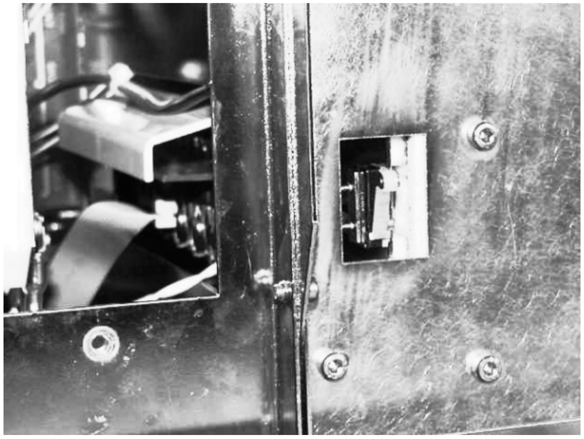
Installation

IMPORTANT The Start switch is connected in the normally open position.

---

1. Connect the new start switch to J34 on the Main card.
2. Position the start switch (with the wheel at the top) in the two slots (Figure 4.21-4).

Figure 4.21-4 Start Switch Orientation



3. Install the two screws that secure the switch to the instrument frame.
4. With the front panel in position, verify that the start cycle key is operating normally.
    - When the Start switch is installed correctly, you will hear a click when the sample bar is pressed and another click when the sample bar is released.
    - If you do not hear the two clicks, move the switch forward or backward until the location is correct.

WARNING Use the washer to connect the ground wiring to the fan.

---

5. Reinstall the fan.
6. Reassemble the front panel. See Heading 4.2, OPENING OR REMOVING INSTRUMENT DOORS, PANELS, AND COVERS, if needed.

4.22 OPTICAL BENCH DISASSEMBLY AND REPLACEMENT

Purpose

Use this procedure to remove, replace, and control the optical bench assembly.

Tools/Supplies Needed

- ☐ Allen wrenches, 3.0 mm and 5.0 mm

Removal

1. Turn the instrument off and unplug the power cord from the instrument or the wall.
2. Remove the left side panel and the top cover from the instrument. For details, see Heading 4.2. Set the left side panel and top cover aside.

CAUTION A flat cable is connected to the rear of the Main card. Be careful when you open the door (where the Main card is attached) that you do not disconnect or damage this cable.

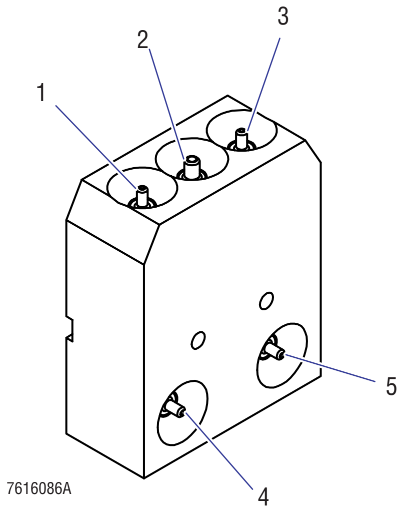
---

3. In the left side compartment,
   a. Turn the two captive knobs counterclockwise to release the Main card door. These knobs are located to the right of the Main card.
   b. Open the Main card door and carefully anchor the door behind the white plastic catch to keep it open.

ATTENTION: The two tubings disconnected from the 5diff syringe are attached to the flow cell. To ensure proper reconnection, you may want to label each tubing with its port number before disconnecting the tubing from the 5diff syringe assembly.

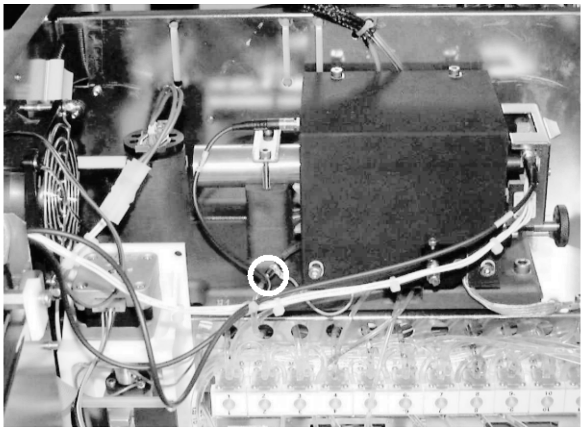
4. At the 5diff syringe, disconnect the tubings attached to ports 1 and 5.

Figure 4.22-1 5diff Syringe Port Locations



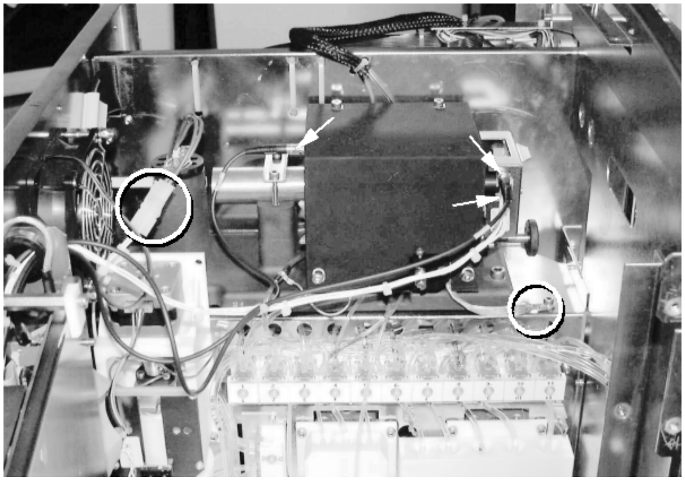
5. At the 11-valve assembly,
    a. Disconnect the tubing attached to solenoid valve 1, port 1.
    b. Disconnect the tubing attached to solenoid valve 4, port 2.
6. Disconnect the tubing attached to the ground fitting (Figure 4.22-2).

Figure 4.22-2 Optical Bench - Ground Fitting Location



7. Disconnect the following components. See Figure 4.22-3 for disconnection locations (from left to right):
    - Lamp supply connector
    - Optical Preamplifier card supply
    - LMNE CIS and LMNE OD coaxes
    - Optical bench grounding wire

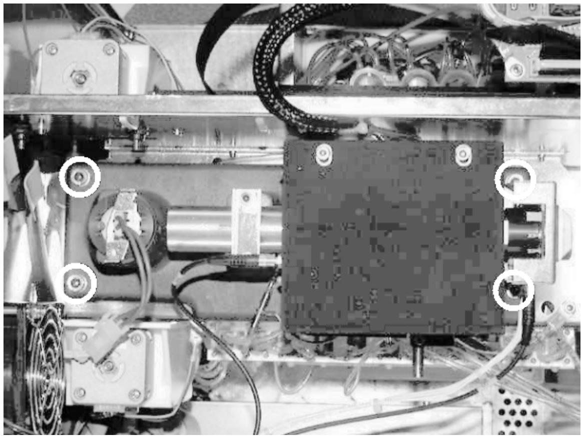
Figure 4.22-3 Disconnection Sites for Named Components



ATTENTION: The optical bench assembly uses captive hex screws mounted inside rubber shock mounts. It is recommended that you use only four turns to either loosen or tighten these screws. Turning the hex screw more than four counterclockwise rotations may separate the screw from the rubber shock mount. If all Service Representatives consistently use four turns to remove or install these hex screws, it is unlikely that a rubber shock mount will separate from its hex screw and fall inside the instrument.

8. Locate the four hex screws circled in Figure 4.22-4. These are captive screws anchored inside rubber shock mounts.

Figure 4.22-4 Captive Screw Locations - Optical Bench Assembly



9. Loosen each hex screw with four counterclockwise rotations (Figure 4.22-4). Use a 5.0 mm Allen wrench.

   Note: If a screw is not released in four rotations, the screw was overtightened the last time the optical bench assembly was serviced. From this point, make a single rotation then check to see if the mount is free. Repeat this sequence of making a single rotation and checking until the mount is free.

10. Gently remove the optical bench from the instrument.

Installation

1. Locate the new optical bench assembly and position it inside the instrument.

   Note: Make sure the rubber shock mounts are positioned behind the panel. The optical bench assembly should be flush against the instrument.

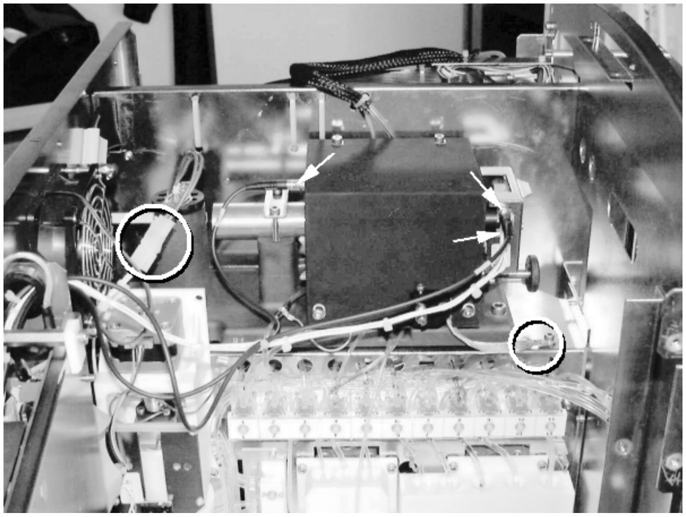
ATTENTION: It is recommended that you use only four clockwise turns to tighten the captive hex screws. As each hex screw is tighten, its rubber shock mount expands to secure the optical bench assembly to the instrument. If all Service Representatives consistently use four turns to install these hex screws, it is unlikely that a rubber shock mount will separate from its hex screw and fall inside the instrument the next time the assembly is removed.

Although you must be careful to not overtighten the rubber shock mounts, make sure the optical bench is mounted securely. The assembly should not move if you try and lift it.

2. Tighten the four captive hex screws using four clockwise rotations (Figure 4.22-4). Use a 5.0 mm Allen wrench.

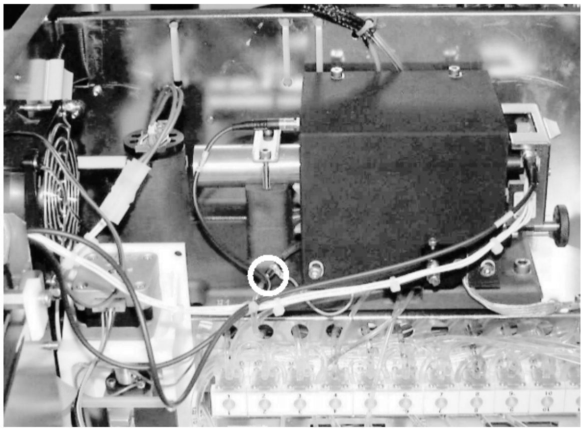
3. Reconnect the following components. See Figure 4.22-5 for connection locations (from left to right):
   - Lamp supply connector
   - Optical Preamplifier card supply
   - LMNE CIS and LMNE OD coaxes
   - Optical bench grounding wire

Figure 4.22-5 Connection Sites for Named Components



4. Reconnect the tubing attached to the ground fitting (Figure 4.22-6).

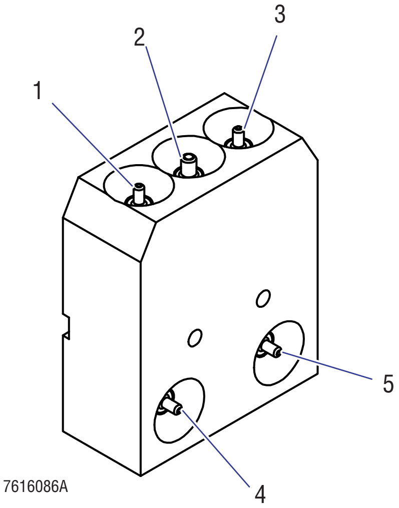
Figure 4.22-6 Optical Bench - Ground Fitting Location



5. Reconnect the two hydraulic tubings as follows:
   a. Attach the tubing connected to the isolator chamber to solenoid valve 1, port 1.
   b. Attach the tubing connected to the flow cell (T-connector) to solenoid valve 4, port 2.

6. At the 5diff syringe, reattach the two flow cell tubings to their proper ports, port 1 and port 5.

Figure 4.22-7 5diff Syringe Port Locations



7. When the installation is completed, go to Heading 4.4, FLOW CELL CHECKS AND ADJUSTMENTS to ensure proper flow cell operation.

4.23 BAR-CODE READER TESTING AND CONFIGURATION

Purpose

Use this procedure to test, troubleshoot, and reconfigure the bar-code reader.

Read Test

Verify the bar-code reader is working properly by successfully reading the test labels. That is, when the bar-code reader is programmed to the default configuration, the reader successfully reads all the labels in Table 4.23-1 and the Codabar label in Table 4.23-2.

If the bar-code reader fails to read the bar-code labels as specified, restore the reader to the default settings, perform the Read Test again, then program each bar-code option per lab requirements.

IMPORTANT There is a risk of sample misidentification if the entire bar code is not captured with the bar-code reader, especially with the Interleaved 2-of-5 bar-code format. Position the bar-code reader over the label to capture the entire bar-coded identification. Otherwise, part of the identification may not be scanned, resulting in misidentification. Just as an operator must pass the bar-code reader over the bar-code label on the specimen tube to capture the entire bar-coded sample ID, make sure the entire label is read to avoid possible misidentification.

Table 4.23-1 Test Labels With Check Digit (Checksum)

12345ABCDE Code 128	1234567 EAN 8 Reads 123456770
123ABC$ Code 39 If this label is read with Check Digit disabled, the last character "$" is also displayed.	1 234567 890128 EAN13 Reads 12345678901228
123456789012 Interleaved 2-of-5 Reads 11 characters with Check Digit or reads 12 characters without Check Digit.	

Table 4.23-2 Test Labels Without Check Digit

123ABC Code 39 Label will not read if scanner is programmed to default condition	A123123A Codabar

Default Settings

Do this procedure when the Read Test fails or you want to restore the default settings to the bar-code reader. The default values are shown below.

Setting	**Code 128❶**	**Code 39**	**Codabar**	**I 2-of-5**	**EAN 8**	**EAN 13**
Character Length	1 to 16	1 to 16	3 to 16	11❸	7	12
Check Digit (Checksum)❷	Always Enabled	Enabled	Not Available	Enabled	Always Enabled	Always Enabled
Start/Stop Equality Check	Not Available	Not Available	Enabled	Not Available	Not Available	Not Available
Start/Stop Equality Output	Not Available	Not Available	Disabled	Not Available	Not Available	Not Available

❶ *Code 128 provides excellent density, alphanumeric characters, and good security. Recommend using this symbology if using barcodes for the first time, and if compatible with other bar code systems used in your lab.*

❷ *For increased sample identification integrity, always use Check Digit (Checksum).*

❸ *Number of characters for I 2-of-5 can be programmed for other lengths, including variable length. However, the variable length is NOT recommended for I 2-of-5 due to the possibility of capturing a partial read of the bar code label.*

1. If the instrument is on, turn the instrument off then back on again before starting programming.
2. Read in the bar-code labels in Table 4.23-3 from top to bottom and left to right. Bar codes with $+ and $- will sound multiple beeps when read. Other codes will only sound a single beep.
3. When the last label is read, do the Read Test again.

Table 4.23-3 Bar-code Labels for Default Configuration

$+CQ0$-	AB13AB*0116	EB3EHB54FF
$+CP0$-	AC131212	EB3EHNFFFF
$+$*	AI11	EB3EHVFFFF
$+	AD121AD*0316	EB3EHRFFFF
CA0CC1CE2	EA110DEC0	EB3EHTFFFF
AZ0AA3	EB3EHA45FF	$-
$+CQ0$-	AB13AB*0116	EB3EHB54FF

Read in one of the Code 39 labels below to change the Check Digit option.

$+AB11$-	$+AB13$-
Code 39 No Check Digit control	Code 39 Check Digit control

Codabar - Start/Stop Equality Check/Output

If you want to change the Start/Stop Equality Check/Output default setting (*start/stop equality check but no transmissions)*, read in one of the labels below.

$+AD111$-	$+AD112$-
No Start/Stop Equality Check Nor Transmission	No Start/Stop Equality Check But Transmission
$+AD121$-	$+AD122$-
Start/Stop Equality Check But No Transmission	Start/Stop Equality Check And Transmission

Interleaved 2-of-5 Options

If you want to change the Interleaved 2-of-5 default setting (*check digit with 11 digits)*, read in one of the labels for check digit control and select one of the labels to set the number of digits.

Note: To increase sample identification integrity, use fixed length digits with Check Digit.

When check digit is enabled, the available digits are: 3, 5, 7, 9, 11, 13, 15, and variable (3 to 15).

When check digit is disabled, the available digits are: 4, 6, 8, 10, 12, 14, 16 and variable (4 to 16).

Variable length digits are NOT recommended for Interleaved 2-of-5 bar codes. If the test label fails to read, reset the scanner by turning the instrument off then on and repeating the programming sequence.

Number of Digits	**With Check Digit Control**	**No Check Digit Control**	**Fixed Digit Test Labels**
	Read this label first, then ONE of the other labels below $+AC0$-	Read this label first, then ONE of the other labels below $+AC0$-	
3* or 4†	$+AC130404$-	$+AC110404$-	1236
5* or 6†	$+AC130606$-	$+AC110606$-	123457
7* or 8†	$+AC130808$-	$+AC110808$-	12345670

Number of Digits	With Check Digit Control	No Check Digit Control	Fixed Digit Test Labels
9* or 10†	$+AC131010$-	$+AC111010$-	1234567895
11* or 12†	$+AC131212$-	$+AC111212$-	123456789012
13* or 14†	$+AC131414$-	$+AC111414$-	12345678901231
15* or 16†	$+AC131616$-	$+AC111616$-	1234567890123452
[3 to 15]* or [4 to 15]†	$+AC130416$-	$+AC110416$-	

*= With Check Digit Control
†= No Check Digit Control

4.24 REAGENT SYRINGES ASSEMBLY REPLACEMENTS

Purpose

Use this procedure to remove and replace the reagent syringe pistons, O-rings, or washers.

The reagent syringes assembly consists of five reagent syringes. With the exception of the Hgb Lyse syringe (the syringe with the smallest diameter), each syringe piston has both a washer and an O-ring. The Hgb Lyse syringe has an O-ring but no washer.

When performing this procedure to replace an O-ring or a washer, replace both. When replacing a syringe piston, replace its O-ring and washer as well.

Tools/Supplies Needed

☐ Allen wrench, 3 mm

☐ Torque screwdriver, 2.5 mm and T10 torx

Note: 400 mN.m (56.8 ozf.in) torque is required in this procedure.

☐ Absorbent paper towels

☐ Replacement parts, available as needed

- Washer and silicone O-ring, PN - XDA622A

  Note: Four sets are needed when performing 6-months, 1-year, or every 2-years maintenance.
- Reagent syringe piston (except Hgb Lyse), PN - GBC030A

  Note: Four syringe pistons are needed when performing two-year maintenance.
- Hgb Lyse reagent syringe piston, PN - GBC031A
- Silicone O-ring for the Hgb Lyse reagent syringe piston, PN - FAA065A
- Silicone grease, PN - XEA019A

Preparation

1. If off, turn the instrument on.
2. From the Service menu, select **9. OTHERS ▸▸ 3. PARK SYRINGES**.
3. Turn the instrument off and disconnect the power cord.
4. Remove the left side door.

CAUTION A flat cable is connected to the rear of the Main card. Be careful when you open the door (where the Main card is attached) that you do not disconnect or damage this cable.

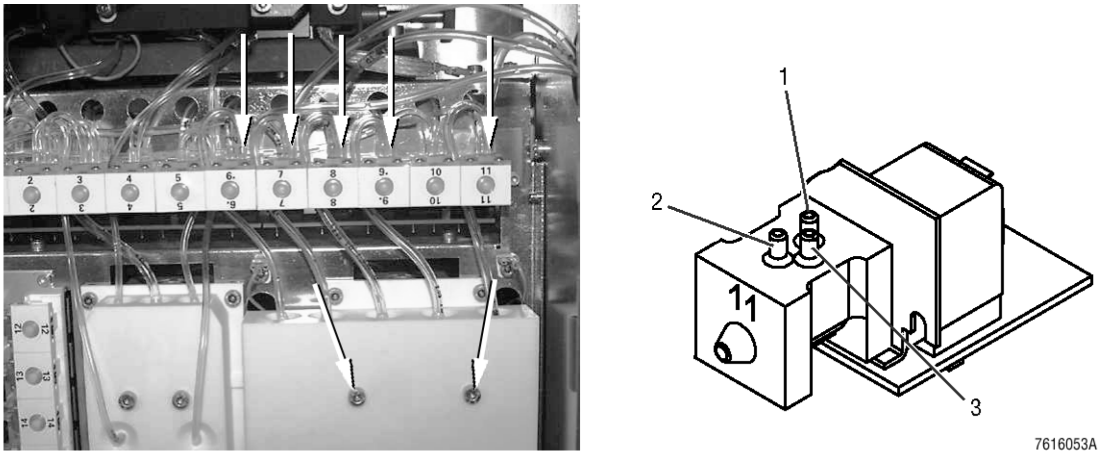
---

5. Open the Main card door and anchor the door so that it remains open.

Removal

1. Disconnect the tubing attached to port 3 at valves 6, 7, 8, 9, and 11 (Figure 4.24-1):

Figure 4.24-1 Valve and Screw Locations - Left Side View



2. Remove the two hex screws securing the reagent syringes assembly (Figure 4.24-1). Use a 3 mm Allen wrench.
3. Gently remove the reagent syringes assembly from the instrument.
4. Hold the reagent syringes assembly over a waste container and drain the syringes by manually pushing the pistons up and down inside the syringe barrels.

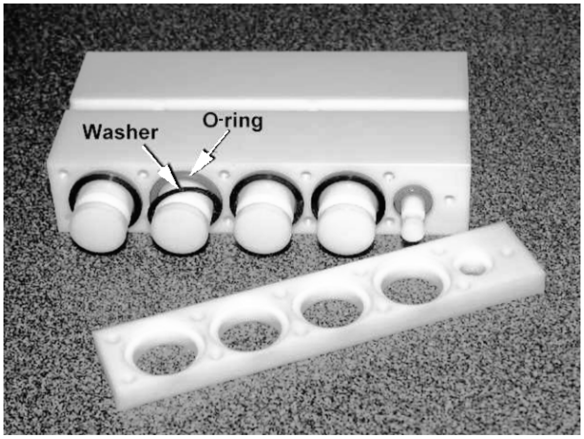
   Note: Selecting the **PARK SYRINGES** option at the beginning of this procedure, activated an upward movement of the syringe pistons dispensing most of the reagent contained inside the syringe. This manual up and down movement of the pistons is done to drain residual reagent so that all syringes are relatively dry before proceeding.
5. Place the drained assembly on absorbent paper.
6. Wipe the solenoid valves with a lint-free tissue to remove any reagent that dripped on the valves.

O-Ring, Washer, and Piston Replacement

If you are replacing an O-ring or washer, replace both. When replacing a syringe piston, replace the O-ring and washer too. Complete needed replacements before proceeding to the Installation instructions.

CAUTION With the exception of the Hgb Lyse reagent piston, each syringe piston has both a washer and an O-ring. Compression of the O-ring is critical for a good piston seal. For this reason, the thickness of the washer is matched to the O-ring thickness. As a result, it is important to keep the O-ring and its matching washer together. The Hgb Lyse reagent syringe uses an O-ring but does not use a washer on its piston. See Figure 4.24-2.

Figure 4.24-2 O-rings and Washers - Reagent Syringes Assembly



1. Remove the nine hex screws (CHC M3x12) and the two torx screws (FX M3x12) that secure the bottom plate.

   ATTENTION: When replacing parts, remove syringes one at a time and in order. Run fingers along piston to check for scratches or scores. The Fix syringe may be slightly discolored.

2. If you only need to replace an O-ring or washer, go to step 3. If you need to replace a syringe piston, go to step 4.
3. One at a time, replace an old O-ring and washer as follows:
   a. Remove and discard the old washer and O-ring.

      Note: The Hgb Lyse reagent piston has an O-ring but does not have a washer.

   b. Locate the replacement O-ring and washer.
   c. Use a small amount of silicone grease between two fingers to lubricate the O-ring.
   d. Place the O-ring on the syringe piston, followed by the washer (Figure 4.24-2).

      Note: The Hgb Lyse reagent piston does not have a washer.

   e. Repeat step 3 as many times as necessary then proceed to the IMPORTANT message just before step 5.
4. One at a time, replace the old piston, O-ring, and washer as follows:
   a. Remove and discard the old washer and O-ring.

      Note: The Hgb Lyse reagent piston has an O-ring but does not have a washer.

   b. Remove and discard the old syringe piston.
   c. Clean the barrel inside the assembly with lint-free tissues.
   d. Locate the replacement piston, O-ring, and washer.
   e. Use a small amount of silicone grease between two fingers to lubricate the long section of the piston.
   f. Insert the lubricated piston into its barrel.
   g. Use a small amount of silicone grease between two fingers to lubricate the new O-ring.

h. Place the O-ring on the syringe piston, followed by the washer (Figure 4.24-2).

Note: The Hgb Lyse reagent piston does not have a washer.

i. Repeat step 4 as many times as necessary.

IMPORTANT Risk of misleading results. Restricted piston movement affects dilution ratios which may affect final parameter results. The bottom plate on the reagent syringes assembly must be properly aligned to ensure unrestricted movement of the syringe pistons. To ensure alignment, the bottom plate must be installed in two stages with the two torx screws being installed first followed by installation of the nine hex screws. These nine hex screws must be tightened in a zigzag, crisscross pattern to prevent skewing (Figure 4.24-3).

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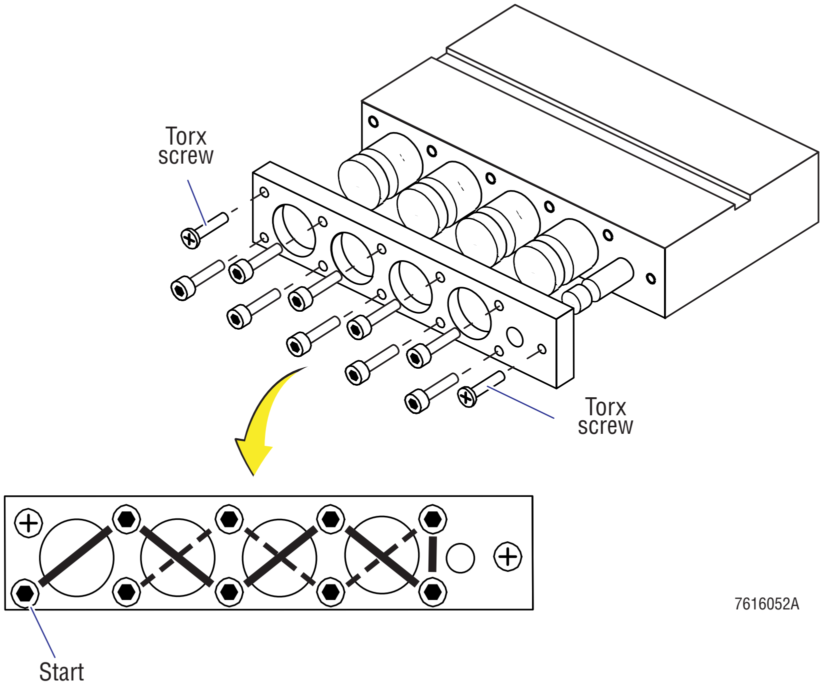
5. When all reagent syringes assembly replacements are complete, replace the bottom plate as follows:
   a. Position the reagent syringes assembly so that the smallest piston is to your right, as shown in Figure 4.24-2.
   b. Carefully replace the bottom plate. Make sure all O-rings and washers are properly seated inside their respective slots.
   c. Loosely install the two torx screws - one screw in the center opening to the right of the small piston; the second, in the upper left corner (Figure 4.24-3).
   d. Loosely install the nine hex screws.

Figure 4.24-3 Bottom Plate Screw Locations and Tightening Patterns



ATTENTION: Torque needed for the two torx screws is 400 mN.m (56.8 ozf.in).

e. Tighten the two torx screws (Figure 4.24-3). Use a torque driver with a T10 torx bit to tighten the screws to 400 mN.m (56.8 ozf.in).

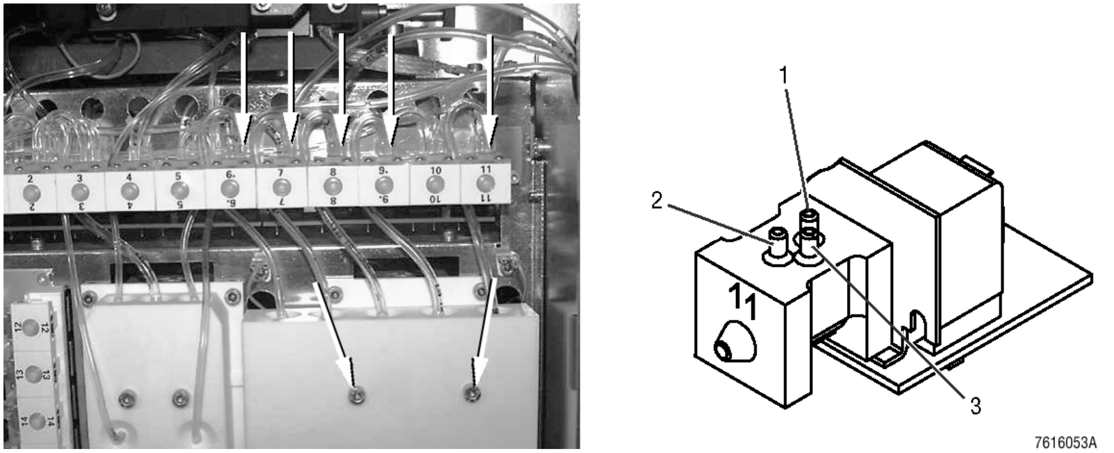
ATTENTION: Torque needed for the nine hex screws is 400 mN.m (56.8 ozf.in). These hex screws must be tighten in a zigzag, crisscross pattern to prevent skewing and ensure proper alignment of the bottom plate (Figure 4.24-3).

f. Tighten the nine hex screws in a zigzag, crisscross pattern (Figure 4.24-3).
   - Use a 2.5 mm torque screwdriver to tighten each screw to 400 mN.m (56.8 ozf.in).
   - Start in the lower left corner and use a zigzag pattern (from left to right) to tighten every other screw. Then reverse the zigzag pattern. Start in the upper right corner and use a right-to-left zigzag pattern to tighten the remaining loose screws (as you crisscross the previous zigzag pattern).

Installation

1. Align the reagent syringes assembly back inside the instrument. Make sure the channel on the back of the assembly housing fits securely on the motor housing guide.
2. Replace the two hex screws that secure the reagent syringes assembly to the instrument (Figure 4.24-4). Use a 3 mm Allen wrench.

Figure 4.24-4 Valve and Screw Locations - Left Side View



3. Thread each tubing up through the hole and reconnect at port 3 of valves 6, 7, 8, 9 and 11 (Figure 4.24-4).

   At the reagent syringes assembly, from left to right:
   - Attach the first tubing (from the Hgb Lyse reagent syringe) to LV6, port 3.
   - Attach the second tubing (from the Rinse reagent syringe) to LV7, port 3.
   - Attach the third tubing (from the Fix reagent syringe) to LV8, port 3.
   - Attach the fourth tubing (from the Diluent reagent syringe) to LV9, port 3.
   - Attach the fifth tubing (from the WBC Lyse reagent syringe) to LV11, port 3.

Verification

1. Reconnect the power cord.
2. Turn the instrument on.

3. When the startup routine and background check are done, verify the reagent syringes assembly is not leaking.
4. If no leakage is seen, prime the reagents.

   From the Main Menu, select **3. REAGENTS ▸▸ 3. PRIME ▸▸ 6. ALL REAGENTS**.
5. When the prime cycles are done, check the reagent syringes assembly for leaks.
6. If no leaks are detected, close the Main card door and reattach the left side door.
7. Perform a system verification. See Heading 5.3, SYSTEM VERIFICATION PROCEDURES.

4.25 COUNT SYRINGE COMPONENT REPLACEMENTS

Purpose

Use this procedure to remove and replace the count syringe piston, O-ring, or washer. When performing this procedure to replace an O-ring or a washer, replace both. When replacing the count syringe piston, replace its O-ring and washer too.

Tools/Supplies Needed

- ☐ Allen wrenches, 2.5 mm, 3 mm
- ☐ T10 torx driver
- ☐ Absorbent paper towels
- ☐ Replacement components, available as needed
  - Washer and O-ring, PN - XDA621A
  - Count syringe piston, PN - GBG052A
  - Silicone grease, PN - XEA019A

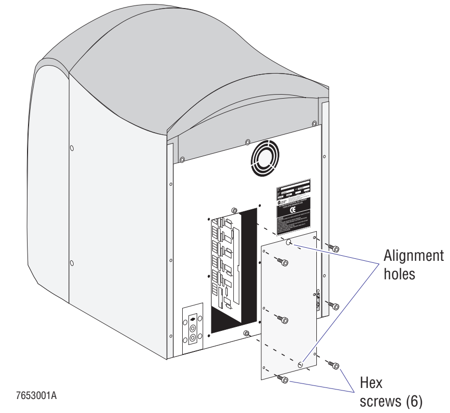
Preparation

1. If off, turn the instrument on.
2. From the Service menu, select **9. OTHERS ▸▸ 3. PARK SYRINGES**.
3. Turn the instrument off.
4. Remove the left side door.

CAUTION A flat cable is connected to the rear of the Main card. Be careful when you open the door (where the Main card is attached) that you do not disconnect or damage this cable.

5. Open the Main card door and anchor the door so that it remains open.
6. At the rear of the instrument,
   a. Disconnect the power cord.
   b. Remove the six hex screws securing the rear access panel (Figure 4.25-1). Use a 3 mm Allen wrench.

Figure 4.25-1 Rear Access Panel Screw Locations

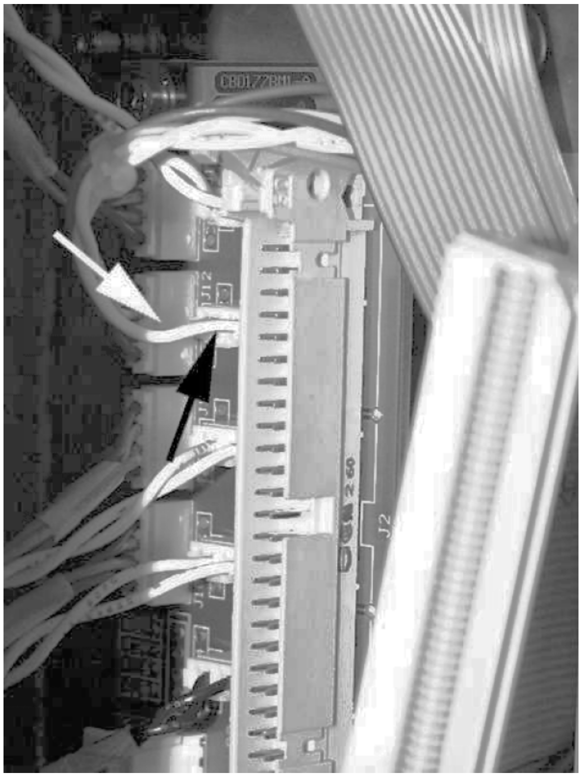


7. Remove the rear access panel and set it aside.

Removal

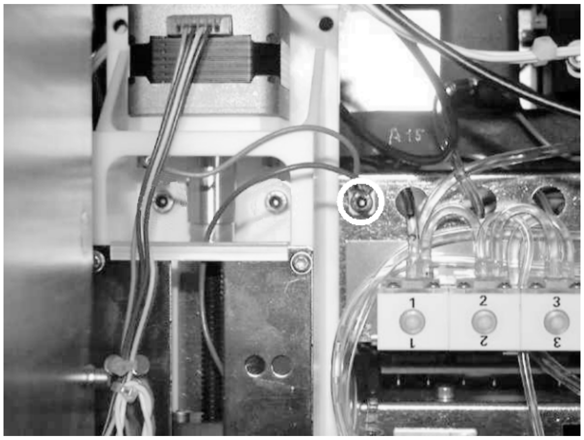
1. At the Motor Interconnect card (Figure 4.25-2):
   a. Disconnect the large (unlabeled) cable connector from the J2 card connector on the card. This allows better access to the individual motor and sensor connectors.
   b. Disconnect sensor connector P7. In Figure 4.25-2, the dark arrow is pointing to this connector. (The J7 connector on the card is oriented in a horizontal position behind the large connector on the Motor Interconnect card. It is the second horizontal connector from the top of the Motor Interconnect card.)
   c. Disconnect motor connector P12. In Figure 4.25-2, the light arrow is pointing to this connector. (The J12 connector on the card is oriented in a vertical position, the second vertical connector from the top of the Motor Interconnect card.)

Figure 4.25-2 Motor Interconnect Card - Count Syringe Connector Locations



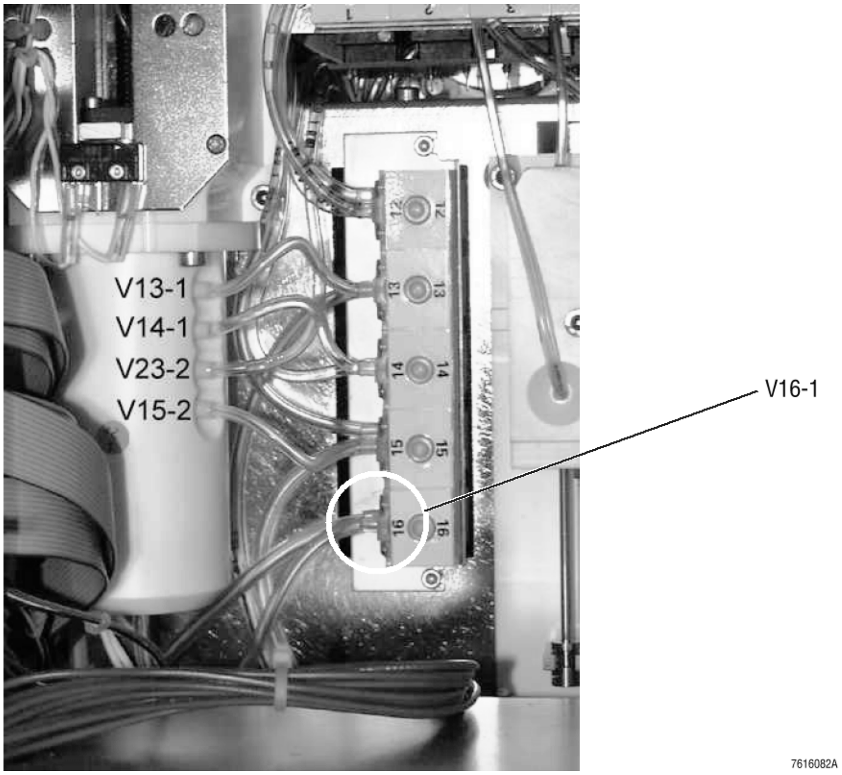
2. In the left side compartment,
   a. Locate the count syringe assembly.
   b. Remove the ground wire from the instrument's frame (Figure 4.25-3).

Figure 4.25-3 Count Syringe - Ground Wire Location



3. Place absorbent paper under the count syringe assembly and the 5-valve assembly to the right of the syringe assembly.
4. Remove the four tubings attached to the fittings on the right side of the syringe housing (Figure 4.25-4).

Figure 4.25-4 Count Syringe Housing - Tubing Locations

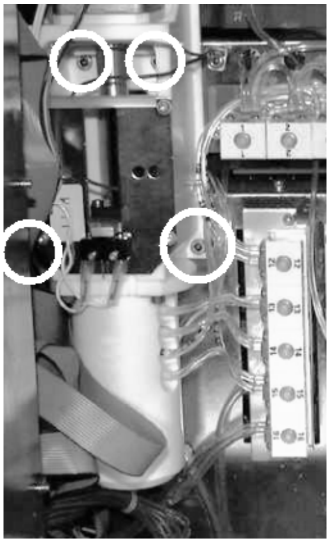


5. Locate the tubing attached to the bottom fitting. Trace this tubing to its connection point on solenoid valve 16. Remove the tubing from LV16, port 1.

ATTENTION: The count syringe assembly uses captive hex screws mounted inside rubber shock mounts. It is recommended that you use only four turns to either loosen or tighten these screws. Turning the hex screw too many counterclockwise rotations may separate the screw from the rubber shock mount. If all Service Representatives consistently use four turns to remove or install these hex screws, it is unlikely that a rubber shock mount will separate from its hex screw and fall inside the instrument.

6. Locate the four hex screws (CHC M4x16) shown in Figure 4.25-5. These are captive screws anchored inside rubber shock mounts. Use a 3 mm Allen wrench.

Figure 4.25-5 Count Syringe - Captive Screw Locations



7. Loosen each hex screw with four counterclockwise rotations (Figure 4.25-5).

   Note: If a screw is not released in four rotations, the screw was overtightened the last time the count syringe assembly was serviced. From this point, make a single rotation then check to see if the mount is free. Repeat this sequence of making a single rotation and checking until the mount is free.

ATTENTION: Ensure the electronic cables are free and unrestricted as you remove the count syringe assembly from the instrument. Do not continue to pull on the count syringe assembly if these cables become restricted. Locate and free the restriction before proceeding.

8. Gently remove the count syringe from the instrument. Make sure the electronic cables remain unrestricted.
9. Hold the count syringe assembly over a waste container and push the piston up and down several times to drain the syringe barrel.

   Note: Selecting the **PARK SYRINGES** option at the beginning of this procedure, activated an upward movement of the syringe piston which expelled most of the reagent inside this syringe. This manual up and down movement of the piston is done to drain residual liquid so that the syringe is relatively dry before proceeding.
10. Place the drained assembly on absorbent paper.

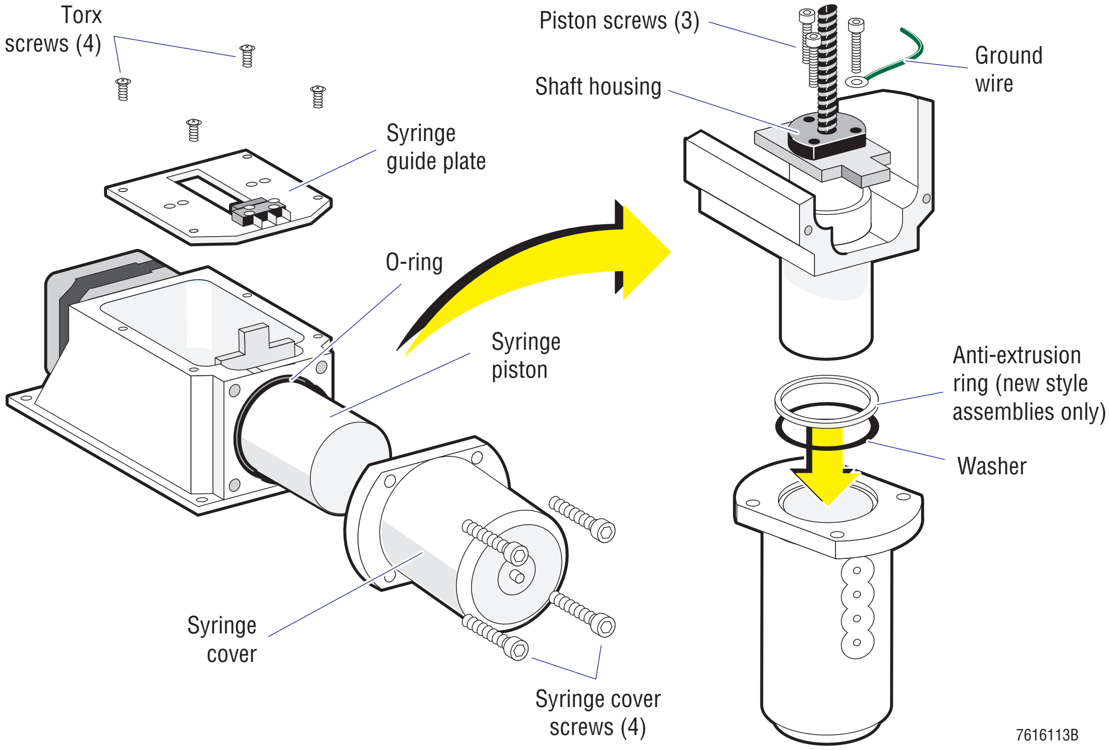
O-ring, Washer, and Piston Replacement

- If you only need to replace an O-ring on a piston or a washer on a housing, replace both using the instructions under the O-ring and Washer Replacement Only heading.
- If you need to replace the syringe piston, replace the O-ring and washer too using the instructions under the Piston Replacement heading.

Piston Replacement

1. Remove the four torx screws securing the syringe guide plate (Figure 4.25-6). Use a T10 torx driver.

Figure 4.25-6 Count Syringe - Piston, O-ring, and Washer Replacement


Torx screws (4)
Syringe guide plate
O-ring
Syringe piston
Syringe cover
Syringe cover screws (4)
Piston screws (3)
Shaft housing
Ground wire
Anti-extrusion ring (new style assemblies only)
Washer
7616113B

2. Remove the syringe guide plate.
3. Remove the four hex screws (CHC M4x16) located around the perimeter of the syringe cover. Use a 3 mm Allen wrench.
4. Remove the cover to expose the syringe piston, O-ring, washer and anti-extrusion ring.
5. Remove and discard the O-ring and washer but retain the anti-extrusion ring.

ATTENTION: Be careful to keep the syringe drive nut in place on the motor lead screw.

6. Manually move piston up to expose the three piston screws.
7. Remove the three piston screws (CHC M3x16). Use a 2.5 mm Allen wrench (one screw has the ground wire). Make sure the shaft housing remains stable.
8. Pull the piston off the shaft housing and remove it by passing it through the end of the frame.

9. Replace the old piston, O-ring, and washer as follows (Figure 4.25-6):
    a. Clean the barrel inside the syringe assembly with lint-free tissues.
    b. Locate the replacement piston, O-ring, and washer.
    c. Position the new piston in the housing and replace the three piston screws (with the ground wire attached). Use a 2.5 mm Allen wrench.
    d. Use a small amount of silicone grease between two fingers to lubricate the long section of the piston and the new O-ring.
    e. Place the O-ring on the syringe piston.

IMPORTANT Risk of erroneous results. The washer must be properly seated in the rim of the syringe housing before reassembling the piston and housing.

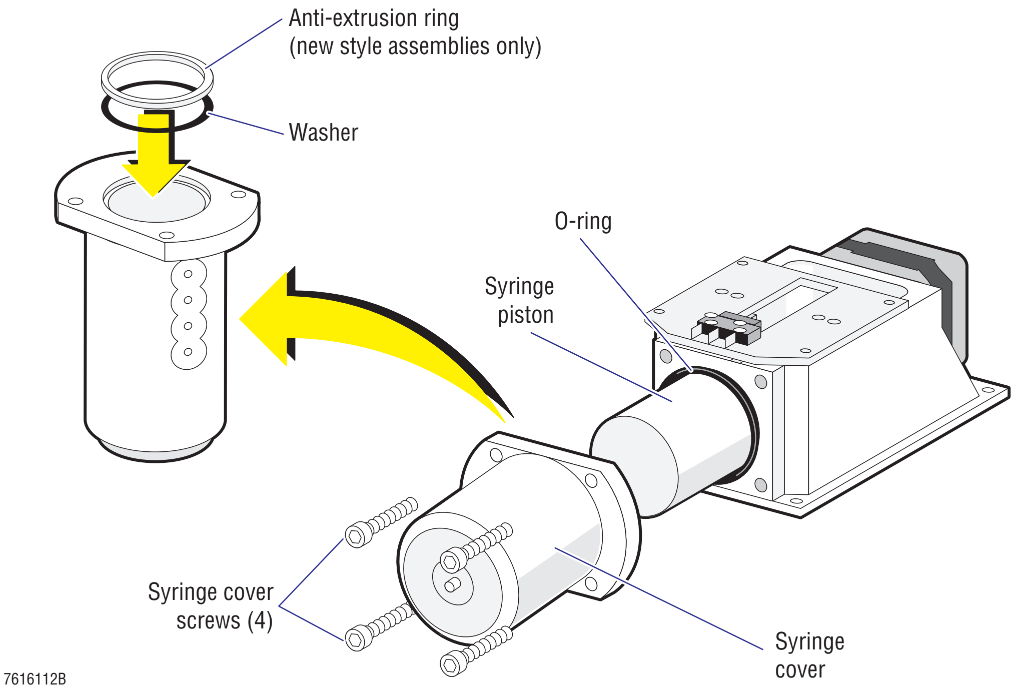
---

    f. Seat washer on rim of syringe housing followed by the anti-extrusion ring.
10. Replace the syringe cover. Make sure the notches on the cover and syringe are aligned. Reinstall the four hex screws around the perimeter of the syringe cover. Use a 3 mm Allen wrench. Make sure washer is not pinched.
11. Position the guide plate on the syringe assembly (notched corners toward the bottom) then secure the plate to the assembly with the four torx screws. Use a T10 torx driver.
12. Go to the Installation heading.

O-ring and Washer Replacement Only

1. Remove the four hex screws (CHC M4x16) located around the perimeter of the syringe cover (Figure 4.25-7).

Figure 4.25-7 Count Syringe - O-ring and Washer Replacement



2. Remove the cover to expose the syringe piston, O-ring, washer and anti-extrusion ring.
3. Remove and discard the O-ring and washer but retain the anti-extrusion ring.
4. Replace the old O-ring and washer as follows (Figure 4.25-7):
   a. Locate the replacement O-ring and washer.
   b. Use a small amount of silicone grease between two fingers to lubricate the O-ring.
   c. Place the O-ring on the syringe piston.

IMPORTANT Risk of erroneous results. The washer must be properly seated in the rim of the syringe housing before reassembling the piston and housing.

---

   d. Seat washer on rim of syringe housing followed by the anti-extrusion ring.
5. Replace the syringe cover. Make sure the notches on the cover and syringe are aligned. Reinstall the four hex screws around the perimeter of the syringe cover. Use a 3 mm Allen wrench. Make sure washer is not pinched.

Installation

1. Position the count syringe assembly back inside the instrument.

   Note: Make sure the rubber shock mounts are positioned behind the panel. The syringe assembly should be flush against the instrument frame.

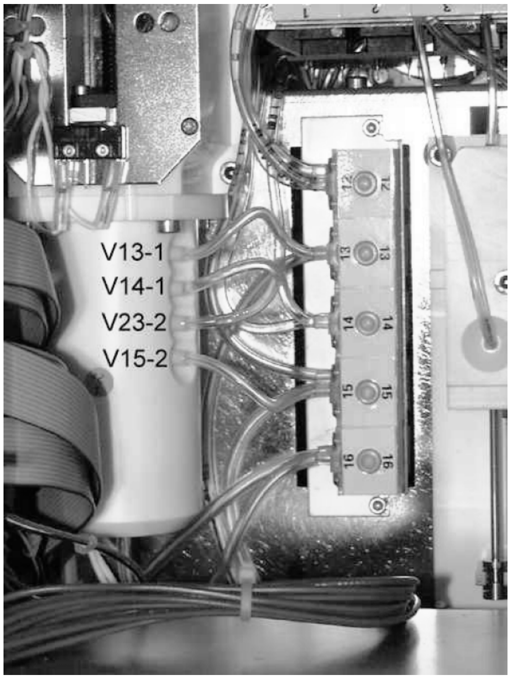
ATTENTION: It is recommended that you use only four clockwise turns to tighten these captive hex screws. As each hex screw is tighten, its rubber shock mount expands to secure the syringe assembly to the instrument frame. If all Service Representatives consistently use four turns to install these hex screws, it is unlikely that a rubber shock mount will separate from its hex screw and fall inside the instrument the next time the assembly is removed.

2. Tighten the four captive hex screws using four clockwise rotations (Figure 4.25-5). Use a 3 mm Allen wrench.
3. Reattach the four tubings to the fittings on the right side of the syringe housing (Figure 4.25-8).

   From the top fitting to the bottom fitting, attach the tubings as follows:

   - Attach the tubing connected to solenoid valve 13, port 1 to the top fitting on the count syringe housing.
   - Attach the tubing connected to solenoid valve 14, port 1 to the second fitting on the count syringe housing.
   - Attach the tubing connected to solenoid valve 23, port 2 to the third fitting on the count syringe housing.
   - Attach the tubing connected to solenoid valve 15, port 2 to the bottom fitting on the count syringe housing.
4. Route the tubing attached to the bottom fitting of the syringe housing to solenoid valve 16. Attach the tubing to port 1.
5. Reconnect the ground wire to the instrument frame (Figure 4.25-3).
6. Route the motor and sensor cables through the opening to the left of the count syringe assembly. Route the connectors over to the Motor Interconnect card.

Figure 4.25-8 Count Syringe Housing - Tubing Locations



7. At the Motor Interconnect card (Figure 4.25-2):
   a. Reattach motor connector P12. In Figure 4.25-2, the light arrow is pointing to this connector. (The J12 connector on the card is oriented in a vertical position near the top of the Motor Interconnect card).
   b. Reattach sensor connector P7. In Figure 4.25-2, the dark arrow is pointing to this connector. (The J7 connector on the card is oriented in a horizontal position behind the large connector on the Motor Interconnect card).
   c. Reattach the large, unlabeled cable connector to the J2 card connector.
8. Replace the rear access panel using the six hex screws removed earlier (Figure 4.25-1).
9. Reconnect the power cord.

Verification

1. Turn the instrument on. An automatic startup and background check are performed.
2. When the startup routine and background check are done, verify the count syringe is not leaking.
3. If no leaks are detected, close the Main card door and reattach the left side door.
4. Perform a system verification. See Heading 5.3, SYSTEM VERIFICATION PROCEDURES.

4.26 SAMPLE PROBE AND RINSE BLOCK ASSEMBLY COMPONENT REPLACEMENTS

Purpose

Use this procedure to remove and replace the sample probe or any part of the rinse block assembly including the probe guide, O-ring, or rinse block.

Tools/Supplies Needed

- ☐ Torque screwdriver, 2.5 mm, hex-ball

  Note: 100 mN.m (14.2 ozf.in) torque is required in this procedure.
- ☐ Replacement parts, available as needed
  - Sample probe, PN - XDA619AS
  - Sample probe guide, PN - GBG091A
  - O-ring, flurocarbon, PN - FAA053A
  - Rinse block, PN - GBG090A
  - Silicone grease, PN - XEA019A

Preparation

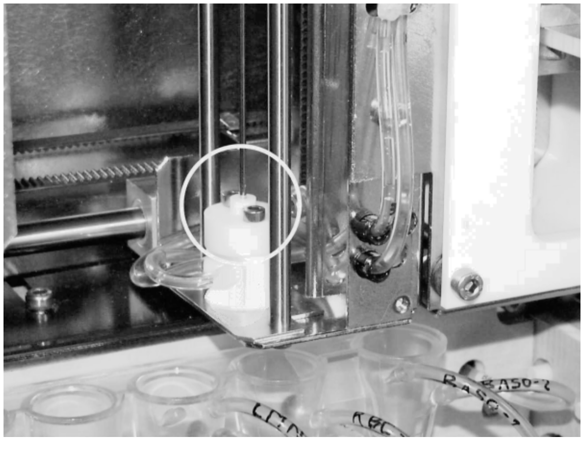
1. If off, turn the instrument on.
2. From the Main Menu, select **4. DIAGNOSTICS ▸▸ 4. HARDWARE SYSTEMS ▸▸ 4. TRAVERSE SERVICE POSITION**.
3. Turn the instrument off.
4. Open the pneumatic access door (right side of the instrument).

Removal

ATTENTION: Note how the existing sample probe and rinse block assembly are seated.

1. Loosen the two hex screws (CHC M3x25) securing the sample probe rinse block assembly on the traverse (Figure 4.26-1). Use a 2.5 mm hex-ball Allen wrench.

Figure 4.26-1 Probe Rinse Block Screw Locations



2. Lift the sample probe lock-lever to free the probe then remove both the probe and rinse block assembly at the same time (Figures 4.26-2 and 4.26-3).

Figure 4.26-2 Lift the Sample Probe Lock-Lever

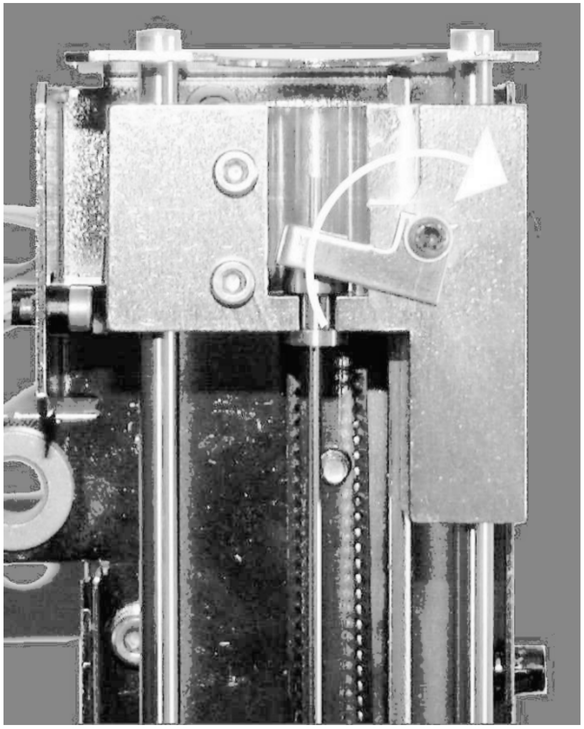
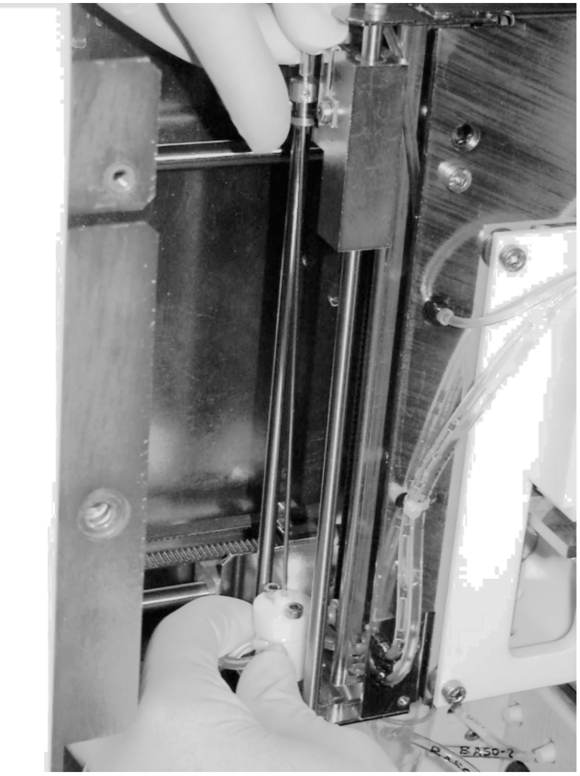


Figure 4.26-3 Remove Probe and Rinse Block Assembly



3. Separate the sample probe and the rinse block assembly.
   - If the sample probe needs replaced, go to the Sample Probe Replacement heading.
   - If one or more rinse block assembly components need replaced,
     - Place the probe back on its support and close the lock-lever.
     - Go to the Rinse Block Assembly Component Replacement heading.

Sample Probe Replacement

1. Remove the tubing attached to the top of the old probe.
2. Attach the new probe.
   - If replacements in the rinse block assembly are required,
     - Place the probe back on its support and close the lock.
     - Go to the Rinse Block Assembly Component Replacement heading.
   - If no other replacements are needed, go to the Installation heading.

Rinse Block Assembly Component Replacement

The rinse block assembly consists of three components: (from top to bottom) the probe guide, a fluorocarbon O-ring, and the rinse block. Complete needed replacements before proceeding to the Installation instructions.

1. Remove the two hex screws.
2. Separate the rinse block assembly and replace components as needed. See step 3 to replace the rinse block and step 4 to replace the O-ring or probe guide.

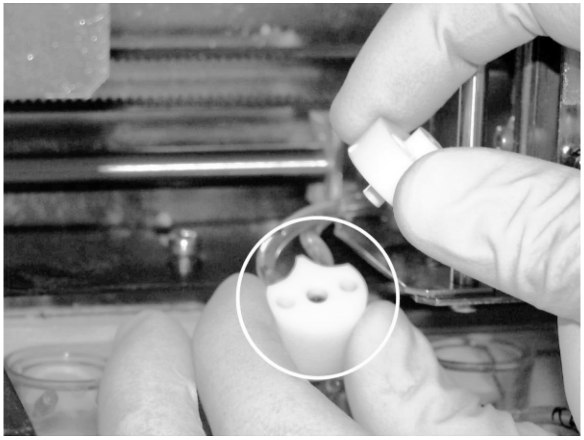
IMPORTANT Risk of erroneous results due to pinching of the tubing. When reattaching tubing from Valves 17 and 18 to new rinse block, route tubing from Valve 17 on inside of guide post, and tubing from Valve 18 around outside of guide post.

---

3. To replace the rinse block:
    a. Place the new rinse block next to the old rinse block. Make sure the new rinse block is oriented the same as the old with the top up and the ports towards the instrument.
    b. Remove tubing from the old rinse block. Route tubing from Valve 18 around outside of guide post and attach to port 1 on the new rinse block. Route tubing from Valve 17 on inside of guide post and attach to port 2 on the new rinse block.
4. To replace the O-ring:
    a. Remove and discard the old O-ring.
    b. Clean then dry the two white blocks. Use a twisted lint free tissue to clean the center opening.
    c. Locate the replacement O-ring.
    d. Use a small amount of silicone grease between two fingers to lubricate the O-ring.
    e. Place the new O-ring inside the probe guide (top block).

    Note: Use a new probe guide if needed.
5. When all rinse block component replacements are complete,
    a. Reassemble the rinse block (Figure 4.26-4).

Figure 4.26-4 Reassemble the Rinse Block Assembly



    b. Route the two hex screws through the openings at the top of the assembly.
    c. Proceed to the Installation heading to complete this procedure.

Installation

1. Lift the probe lock-lever and remove the probe from its support (Figure 4.26-2).
2. Position the probe inside the probe guide, using care not to bend the probe.
3. Lift the probe lock and return the probe and the rinse block assembly back in its original position on the traverse. Position the notch and tubing towards the front of the instrument.
4. Seat the collar of the sample probe by gently pushing it into place then close the lock-lever.

ATTENTION: Torque needed for the rinse block assembly screws is 100 mN.m (14.2 ozf.in).

5. Tighten the two hex screws to secure the rinse block assembly to the traverse carriage (Figure 4.26-1). Use a 2.5 mm, hex-ball torque screwdriver to tighten the screws to 100 mN.m (14.2 ozf.in).

Verification

1. Turn the instrument on.
2. When the startup routine and background check are done, verify the sample probe and the rinse block assembly are not leaking.
3. Close the right side door.
4. Perform a system verification. See Heading 5.3, SYSTEM VERIFICATION PROCEDURES.

4.27 WASTE SYRINGE COMPONENT REPLACEMENTS

Purpose

Use this procedure to remove and replace the waste syringe piston, O-ring, or washer. When performing this procedure to replace an O-ring or a washer, replace both. When replacing the waste syringe piston, replace its O-ring and washer as well.

Tools/Supplies Needed

- ☐ Allen wrenches, 2.5 mm, 3 mm
- ☐ Cutting pliers
- ☐ T10 torx driver
- ☐ Absorbent paper towels
- ☐ Replacement components, available as needed
  - Washer and O-ring, PN - XDA621A
  - Waste syringe piston, PN - GBG052A
  - Silicone grease, PN - XEA019A

Preparation

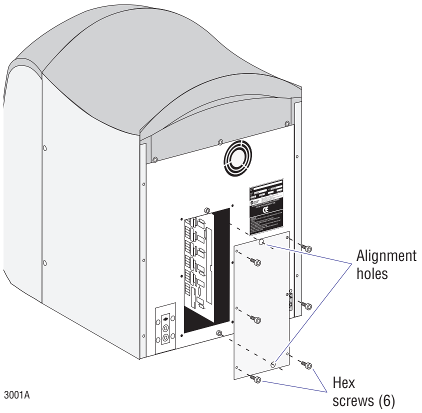
1. Turn the instrument off.
2. Remove the left side door.

CAUTION A flat cable is connected to the rear of the Main card. Be careful when you open the door (where the Main card is attached) that you do not disconnect or damage this cable.

---

3. Open the Main card door and anchor the door so that it remains open.
4. At the rear of the instrument,
   a. Disconnect the power cord.
   b. Remove the six hex screws securing the rear access panel (Figure 4.27-1). Use a 3 mm Allen wrench.

Figure 4.27-1 Rear Access Panel Screw Locations

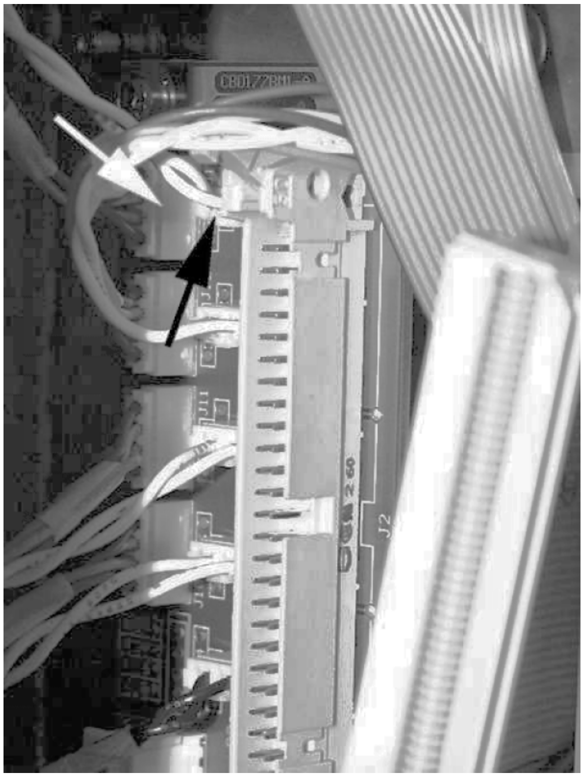


5. Remove the rear access panel and set it aside.

Removal

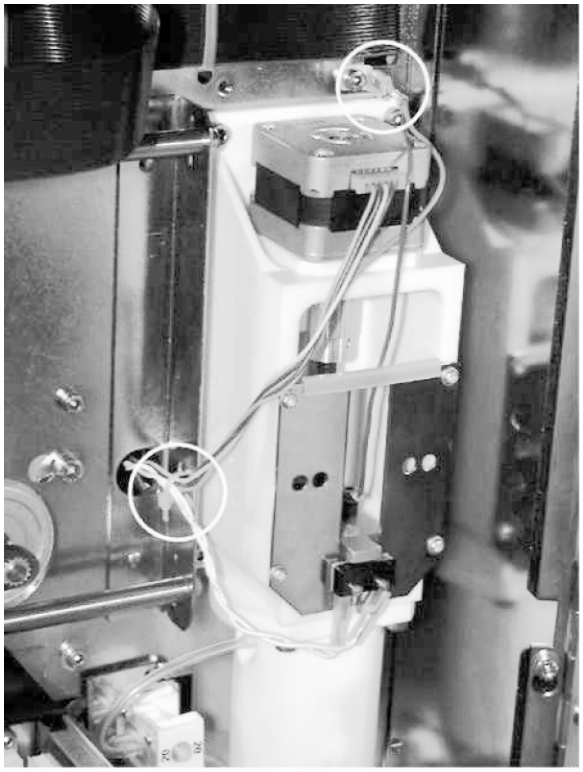
1. At the Motor Interconnect card (Figure 4.27-2),
    a. Disconnect the large, unlabeled cable connector from the J2 card connector. This allows better access to the individual motor and sensor connectors.
    b. Disconnect sensor connector P8. In Figure 4.27-2, the dark arrow is pointing to this connector. (The J8 connector on the card is oriented in a horizontal position behind the large connector on the Motor Interconnect card.)
    c. Disconnect motor connector P13. In Figure 4.27-2, the light arrow is pointing to this connector. (The J13 connector on the card is oriented in a vertical position near the top of the Motor Interconnect card.)

Figure 4.27-2 Motor Interconnect Card - Waste Syringe Connector Locations



2. In the left side compartment,
    a. Locate the waste syringe assembly.
    b. Cut the tie wrap (Figure 4.27-3).
    a. Remove the ground wire from the instrument’s frame.

Figure 4.27-3 Waste Syringe - Tie Wrap and Ground Wire Location



WARNING Risk of personal contamination. If you do not properly shield yourself while servicing the waste syringe assembly, you may become contaminated. To prevent possible biological contamination, you must wear appropriate safety glasses, a lab coat, and gloves when servicing the waste syringe assembly.

---

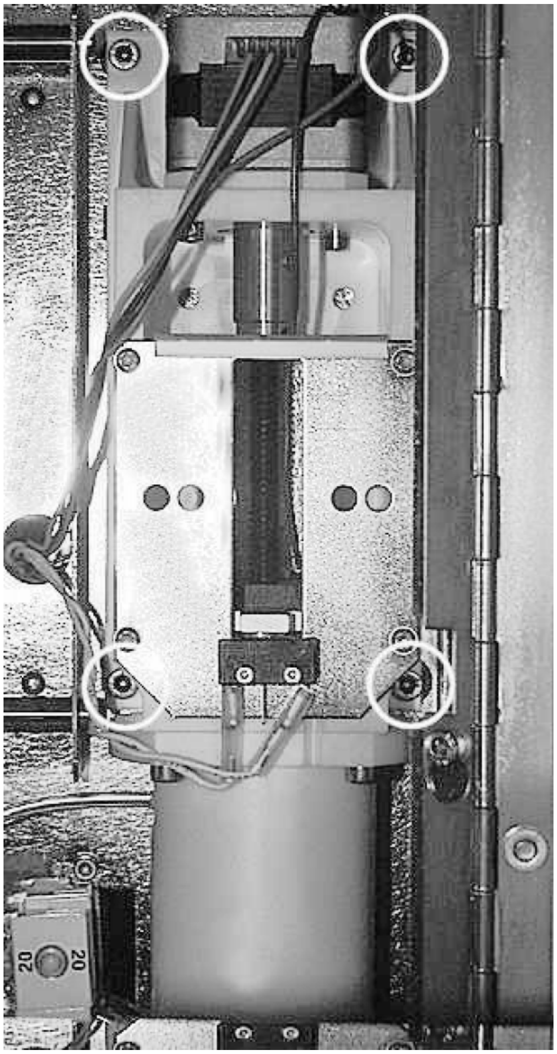
3. Place absorbent paper under the waste syringe and the 7-valve assembly to its left.
4. At the waste syringe, disconnect the two tubings as follows:
   a. Remove the tubing attached to the left side fitting (port 1).
   b. Locate the tubing attached to the bottom fitting (port 2). Trace this tubing to its connection point on LV26. Remove the tubing from LV26, port 3.

      Note: To minimize waste exposure, use a hemostat to clamp this tubing between the 7-valve assembly and the waste syringe before removing the tubing from LV26.

ATTENTION: The waste syringe assembly uses captive hex screws mounted inside rubber shock mounts. It is recommended that you use only four turns to either loosen or tighten these screws. Turning the hex screw more than four counterclockwise rotations may separate the screw from the rubber shock mount. If all Service Representatives consistently use four turns to remove or install these hex screws, it is unlikely that a rubber shock mount will separate from its hex screw and fall inside the instrument.

5. Locate the four hex screws (CHC M4x16) circled in Figure 4.27-4. These are captive screws anchored inside rubber shock mounts. Use a 3 mm Allen wrench.

Figure 4.27-4 Waste Syringe - Captive Screw Locations



6. Loosen each hex screw with four counterclockwise rotations (Figure 4.27-4).

   Note: If a screw is not released in four rotations, the screw was overtightened the last time the waste syringe assembly was serviced. From this point, make a single rotation then check to see if the mount is free. Repeat this sequence of making a single rotation and checking until the mount is free.

ATTENTION: Ensure the electronic cables are free and unrestricted as you remove the waste syringe assembly from the instrument. Do not continue to pull on the waste syringe assembly if these cables become restricted. Locate and free the restriction before proceeding.

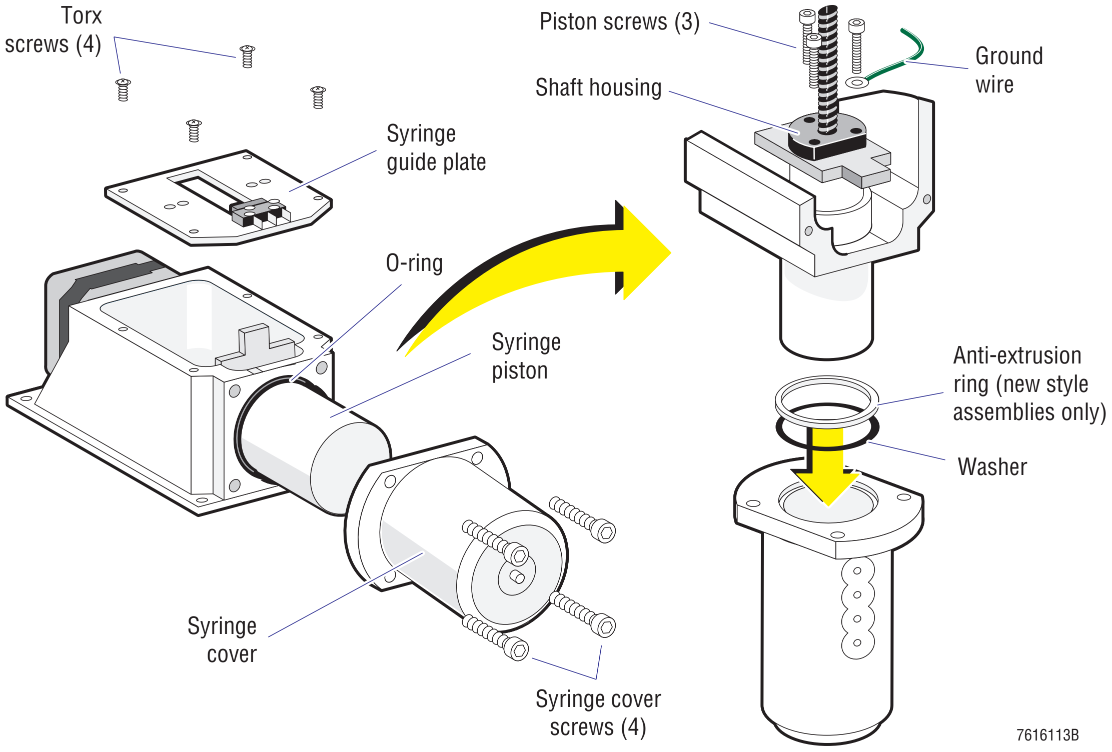
7. Gently remove the waste syringe from the instrument. Make sure the electronic cables remain unrestricted.

8. Hold the waste syringe assembly over a biohazardous waste container and push the piston up and down several times to drain the syringe barrel.
9. Place the drained assembly on absorbent paper.

Piston Replacement

1. Remove the four torx screws securing the syringe guide plate (Figure 4.27-5). Use a T10 torx driver.

Figure 4.27-5 Waste Syringe - Piston, O-ring, and Washer Replacement


Torx screws (4)
Piston screws (3)
Ground wire
Shaft housing
Syringe guide plate
O-ring
Syringe piston
Anti-extrusion ring (new style assemblies only)
Washer
Syringe cover
Syringe cover screws (4)
7616113B

2. Remove the syringe guide plate.
3. Remove the four hex screws (CHC M4x16) located around the perimeter of the syringe cover. Use a 3 mm Allen wrench.
4. Remove the cover to expose the syringe piston, O-ring, washer and anti-extrusion ring.
5. Remove and discard the O-ring and washer but retain the anti-extrusion ring.

ATTENTION: Be careful to keep the syringe drive nut in place on the motor lead screw.

6. Manually move piston up to expose the three piston screws.
7. Remove the three piston screws (CHC M3x16). Use a 2.5 mm Allen wrench (one screw has the ground wire). Make sure the shaft housing remains stable.
8. Pull the piston off the shaft housing and remove it by passing it through the end of the frame.

9. Replace the old piston, O-ring, and washer as follows (Figure 4.27-5):
   a. Clean the barrel inside the syringe assembly with lint-free tissues.
   b. Locate the replacement piston, O-ring, and washer.
   c. Position the new piston in the housing and replace the three piston screws (with the ground wire attached). Use a 2.5 mm Allen wrench.
   d. Use a small amount of silicone grease between two fingers to lubricate the long section of the piston and the new O-ring.
   e. Place the O-ring on the syringe piston.

IMPORTANT Risk of erroneous results. The washer must be properly seated in the rim of the syringe housing before reassembling the piston and housing.

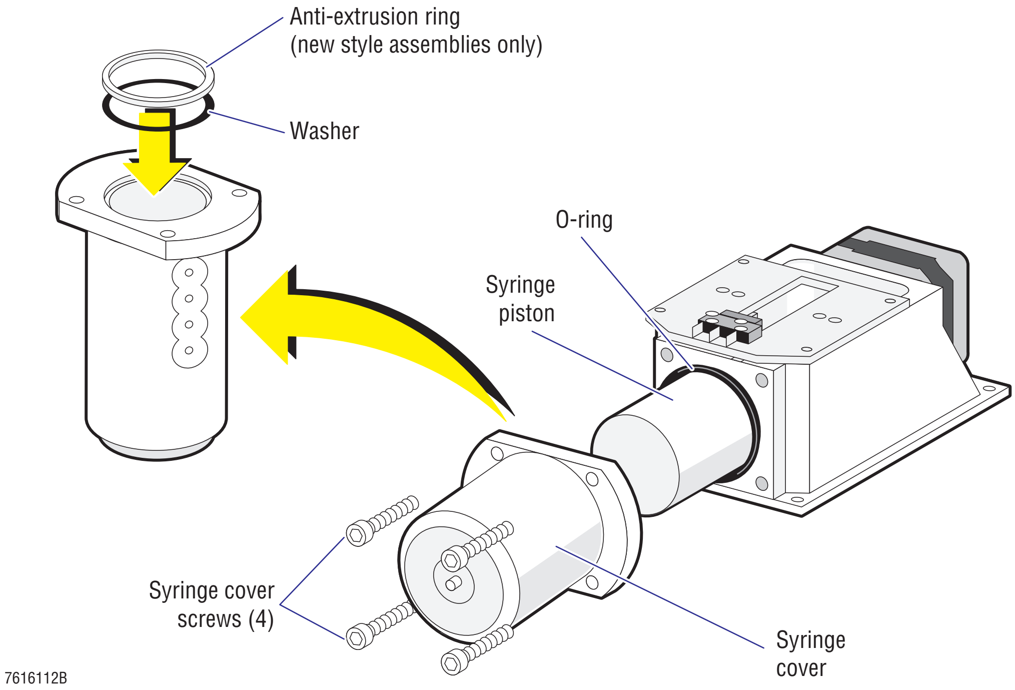
---

   f. Seat washer on rim of syringe housing followed by the anti-extrusion ring.
10. Replace the syringe cover. Make sure the notches on the cover and syringe are aligned. Reinstall the four hex screws around the perimeter of the syringe cover. Use a 3 mm Allen wrench. Make sure washer is not pinched.
11. Position the guide plate on the syringe assembly (notched corners toward the bottom) then secure the plate to the assembly with the four torx screws. Use a T10 torx driver.
12. Go to the Installation heading.

O-ring and Washer Replacement Only

1. Remove the four hex screws (CHC M4x16) located around the perimeter of the syringe cover (Figure 4.27-6).

Figure 4.27-6 Waste Syringe - O-ring and Washer Replacement



2. Remove the cover to expose the syringe piston, O-ring, washer and anti-extrusion ring.
3. Remove and discard the O-ring and washer but retain the anti-extrusion ring.
4. Replace the old O-ring and washer as follows (Figure 4.27-6):
    a. Locate the replacement O-ring and washer.
    b. Use a small amount of silicone grease between two fingers to lubricate the O-ring.
    c. Place the O-ring on the syringe piston.

IMPORTANT Risk of erroneous results. The washer must be properly seated in the rim of the syringe housing before reassembling the piston and housing.

    d. Seat washer on rim of syringe housing followed by the anti-extrusion ring.
5. Replace the syringe cover. Make sure the notches on the cover and syringe are aligned. Reinstall the four hex screws around the perimeter of the syringe cover. Use a 3 mm Allen wrench. Make sure washer is not pinched.

Installation

1. Position the waste syringe assembly back inside the instrument.

   Note: Make sure the rubber shock mounts are positioned behind the panel. The syringe assembly should be flush against the instrument frame.

ATTENTION: It is recommended that you use only four clockwise turns to tighten these captive hex screws. As each hex screw is tighten, its rubber shock mount expands to secure the syringe assembly to the instrument frame. If all Service Representatives consistently use four turns to install these hex screws, it is unlikely that a rubber shock mount will separate from its hex screw and fall inside the instrument the next time the assembly is removed.

2. Tighten the four captive hex screws using four clockwise rotations (Figure 4.27-4). Use a 3 mm Allen wrench.
3. Reconnect the two hydraulic tubings as follows:
    a. Attach the tubing connected to S20 (port 1) to the left side fitting (port 1) on the waste syringe assembly.
    b. Route the tubing attached to the bottom fitting (port 2) to S26. Attach the tubing (with the collar) to port 3.
4. Reconnect the grounding wire to the instrument frame (Figure 4.27-3).
5. Route the motor and sensor cables through the opening to the left of the waste syringe assembly (Figure 4.27-3). Route the connectors over to the Motor Interconnect card.

6. At the Motor Interconnect card (Figure 4.27-2),
   a. Reattach motor connector P13. In Figure 4.27-2, the light arrow is pointing to this connector. (The J13 connector on the card is oriented in a vertical position near the top of the Motor Interconnect card).
   b. Reattach sensor connector P8. In Figure 4.27-2, the dark arrow is pointing to this connector. (The J8 connector on the card is oriented in a horizontal position behind the large J2 connector on the Motor Interconnect card).
   c. Reattach the large unlabeled cable connector to the J2 card connector.
7. Replace the rear access panel using the six hex screws removed earlier (Figure 4.27-1).
8. Reconnect the power cord.

Verification

1. Turn the instrument on. An automatic startup and background check are performed.
2. When the startup routine and background check are done, open the right side door and verify the waste syringe is not leaking.
3. If no leaks are detected, perform a system verification. See Heading 5.3, SYSTEM VERIFICATION PROCEDURES.

4.28 CLEANING THE BATH ENCLOSURE

Purpose

Use this procedure to clean bath enclosure parts with diluted bleach. This procedure provides instructions for cleaning the:

- Black plastic that covers the baths (attached to the right side door).
- White plastic under the baths.
- Top of the hemoglobin bath.

Tools/Supplies Needed

- ☐ High quality, fragrance-free bleach (10-12% sodium hypochlorite - available chloride)
- ☐ Deionized water
- ☐ Absorbent paper towels
- ☐ Lint-free tissues

Procedure

1. Prepare a 1:5 bleach solution: 4 parts deionized water to 1 part high quality, fragrance-free bleach (10-12% sodium hypochlorite - available chloride).
2. Turn the instrument off.
3. Open the pneumatic access door (right side of the instrument).

WARNING Risk of personal contamination. If you do not properly shield yourself while servicing the waste syringe assembly, you may become contaminated. To prevent possible biological contamination, you must wear appropriate safety glasses, a lab coat, and gloves when servicing the waste syringe assembly.

ATTENTION: Do not use a sponge or cloth to clean instrument assemblies. Use absorbent paper towels that can be discarded in a biohazardous container. For small or sensitive assemblies such as the top of the hemoglobin bath, use lint-free tissues.

4. Pour the diluted bleach on a soft paper towel and thoroughly clean the black plastic that covers the baths (attached to the right side door) and the white plastic under the baths.
5. Wipe the plastic dry with a clean paper towel.
6. Discard the towels in a biohazardous container.
7. Wet a lint-free tissue with the diluted bleach and clean the top of the hemoglobin bath.
8. Wipe the top of the bath dry with a clean lint-free tissue.
9. Discard the tissues in a biohazardous container.
10. Close the pneumatic access door (right side of the instrument).
11. Turn the instrument on. An automatic startup and background check is performed.
12. When the startup routine and background check are done, resume normal operation.

4.29 5diff SYRINGE ASSEMBLY REPLACEMENTS

Purpose

The 5diff syringe consists of one large center piston with a smaller injector piston on each side. Use this procedure to remove and replace the 5diff syringe O-rings associated with this center piston and the two injector pistons. Two types of O-rings are used in the 5diff syringe. The large silicone O-ring is used for the center piston and two smaller fluorocarbon O-rings are used on each injector piston. Although this procedure focuses on O-ring replacement, it could be used as a guide in replacing any component inside the 5diff syringe housing or for replacing the entire 5diff syringe assembly.

Tools/Supplies Needed

- ☐ Allen wrenches, 2.5 mm, 3 mm
- ☐ Torque screwdriver, 2.5 mm and T10 torx

  Note: 400 mN.m (56.8 ozf.in) torque is required in this procedure.
- ☐ Replacement components
  - Silicone O-ring, PN - FAA040A
  - Four fluorocarbon O-rings, PN - FAA067A
  - Silicone grease, PN - XEA019A

Preparation

1. If off, turn the instrument on.
2. From the Service menu, select **9. OTHERS ▸▸ 3. PARK SYRINGES**.
3. Turn the instrument off and unplug the power cord from the instrument or the wall.
4. Remove the left side panel from the instrument. For details, see Heading 4.2. Set the panel aside.

CAUTION A flat cable is connected to the rear of the Main card. Be careful when you open the door (where the Main card is attached) that you do not disconnect or damage this cable.

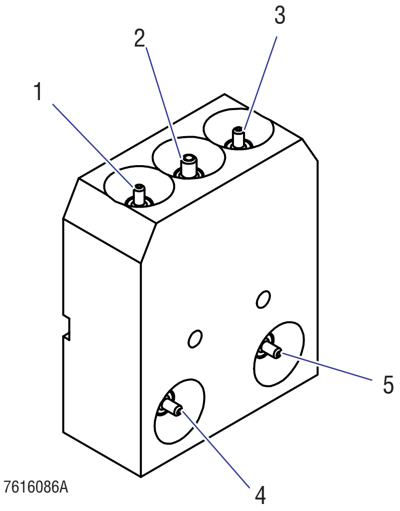
5. In the left side compartment,
   a. Turn the two captive knobs counterclockwise to release the Main card door. These knobs are located to the right of the Main card.
   b. Open the Main card door and carefully anchor the door behind the white plastic catch to keep it open.

Removal

WARNING Risk of personal contamination. If you do not properly shield yourself while servicing the 5diff syringe assembly, you may become contaminated. To prevent possible biological contamination, you must wear appropriate safety glasses, a lab coat, and gloves when servicing the 5diff syringe assembly.

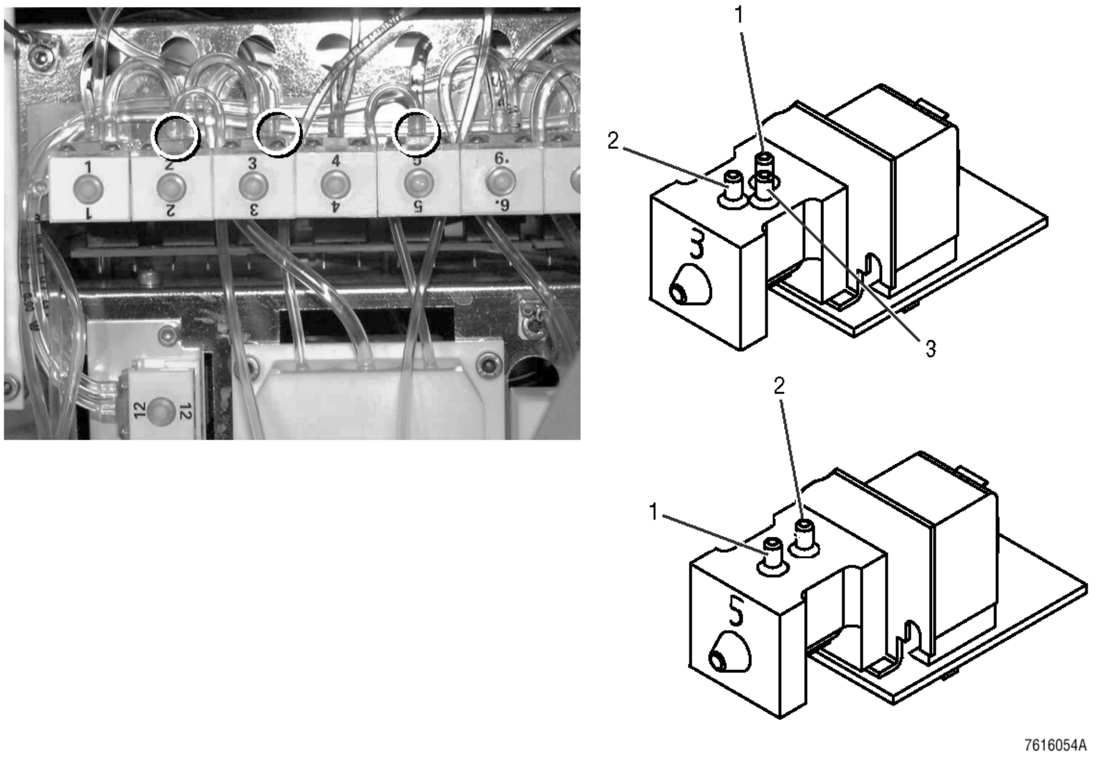
1. At the 5diff syringe assembly, disconnect the two tubings associated with the flow cell:
   a. Disconnect the tubing attached to port 1 (Figure 4.29-1).
   b. Disconnect the tubing attached to port 5 (Figure 4.29-1).

Figure 4.29-1 5diff Syringe Port Locations



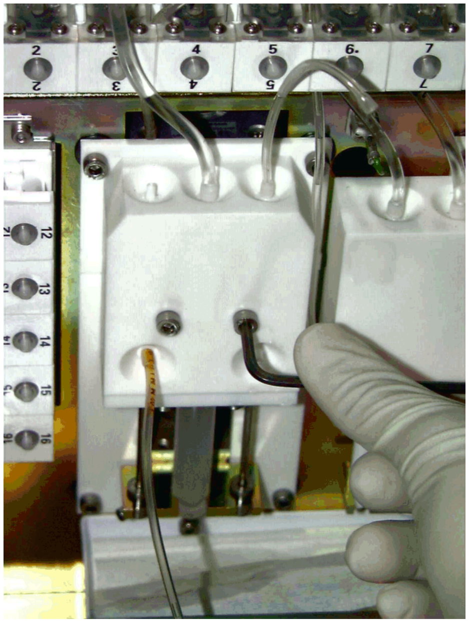
2. Disconnect the other three tubings at the 11-valve assembly (Figure 4.29-2):
   a. Disconnect the tubing attached to valve 2, port 2.
   (The other end of this tubing is attached to 5diff syringe port 4, the lower left port.)
   b. Disconnect the tubing attached to valve 3, port 3.
   (The other end of this tubing is attached to 5diff syringe port 2, upper middle port.)
   c. Disconnect the tubing attached to valve 5, port 1.
   (The other end of this tubing is attached to 5diff syringe port 3, upper right port.)

Figure 4.29-2 Valve and Tubing Locations - Left Side View



3. Remove the two screws on the front of the 5diff syringe housing (Figure 4.29-3). Use a 3.0 mm Allen wrench.

Figure 4.29-3 Screw Locations - 5diff Syringe

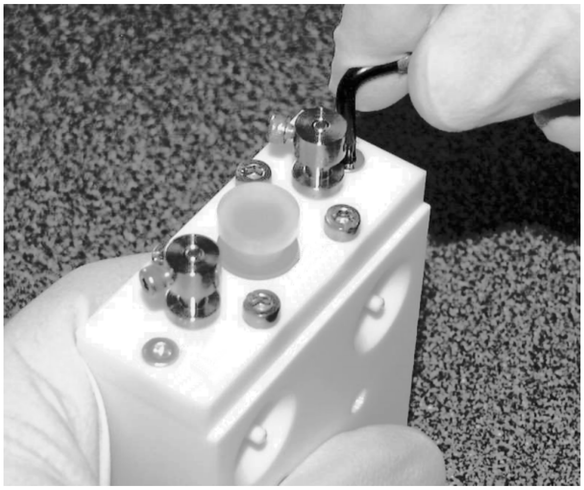


4. Remove the 5diff syringe assembly.
5. Place the syringe assembly on absorbent paper.

O-ring Replacements

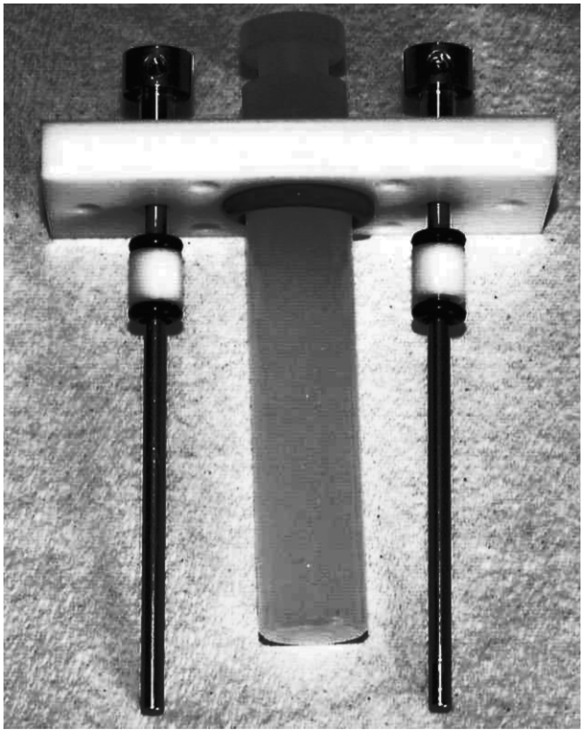
1. At the bottom plate (Figure 4.29-4),
    a. Remove the two torx screws (FX M3x12) that are flush with the bottom plate. Use a T10 torx driver.
    b. Remove the four hex screws (CHC M3x12) using a 2.5 mm Allen wrench.

Figure 4.29-4 Bottom Plate - 5diff Syringe



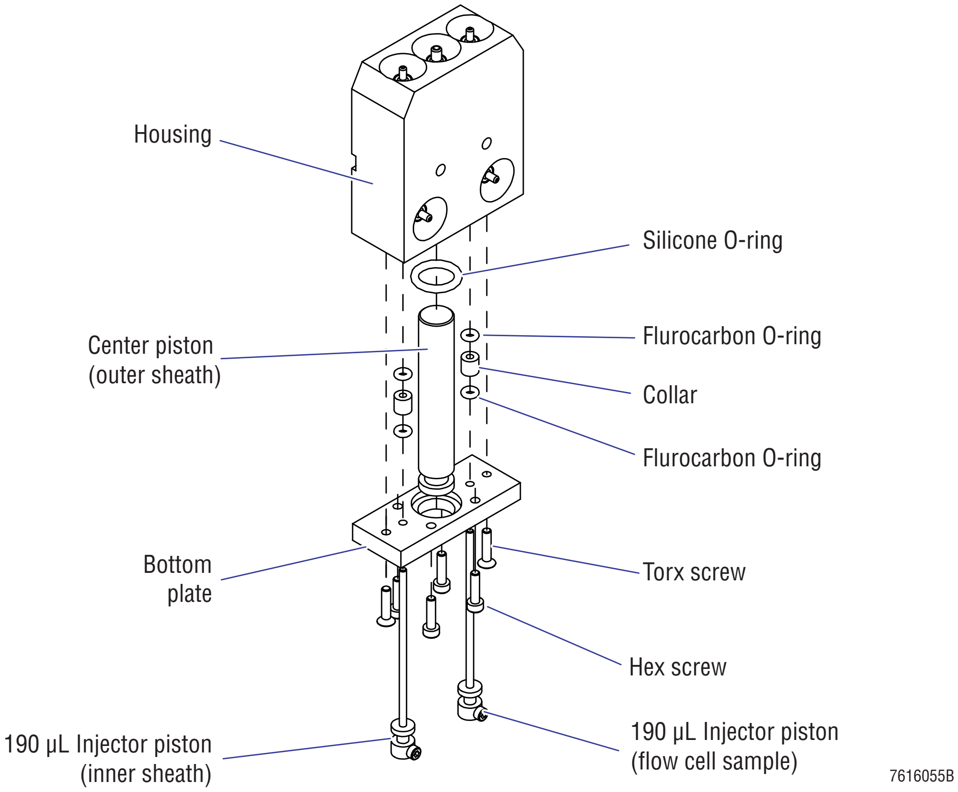
2. Separate the bottom plate (and attachments) from the 5diff syringe housing (Figure 4.29-5).

Figure 4.29-5 Bottom Plate and Attachments - Housing Removed



3. Clean then dry the outside of the 5diff syringe housing.
4. Replace the O-rings on the 190 µL injector piston located on each side of the center syringe piston (Figure 4.29-6):
   a. Remove the two O-rings and the collar from each injector piston.
   b. Discard the four old O-rings. Save the two collars.
   c. Clean the outside of the injector pistons, the center piston, and the bottom plate.
   d. Locate the four replacement fluorocarbon O-rings.
   e. Use a small amount of silicone grease between two fingers to lubricate an O-ring then place it on the injector piston.
   f. Place the collar on the injector piston.
   g. Use a small amount of silicone grease between two fingers to lubricate another O-ring then place it on the injector piston.
   h. Repeat steps e through g to replace the O-rings on the other injector piston.

Figure 4.29-6 Illustrated Parts - 5diff Syringe


Housing
Silicone O-ring
Center piston (outer sheath)
Flurocarbon O-ring
Collar
Flurocarbon O-ring
Bottom plate
Torx screw
Hex screw
190 µL Injector piston (inner sheath)
190 µL Injector piston (flow cell sample)
7616055B

5. Use a small amount of silicone grease between two fingers to lubricate the silicone O-ring before installing this O-ring on the syringe piston.
6. Once all replacements are complete, replace the bottom plate as follows (Figure 4.29-6):
    a. Carefully replace the bottom plate. Make sure the piston O-ring is properly seated inside the slotted opening on the bottom plate.
    b. Loosely install the two torx screws in the two outside openings.
    c. Loosely install the four hex screws.

    ATTENTION: Torque needed for the two torx screws is 400 mN.m (56.8 ozf.in).

    d. Tighten the two torx screws. Use a torx driver with a T10 torx bit to tighten the screws to 400 mN.m (56.8 ozf.in).

    ATTENTION: Torque needed for the four hex screws is 400 mN.m (56.8 Ozf.in). These hex screws must be tightened in a crisscross pattern to prevent skewing and ensure alignment of the bottom plate.

    e. Tighten the four hex screws in a crisscross pattern.
        - Use a 2.5 mm torque screwdriver to tighten each screw to 400 mN.m (56.8 ozf.in).
        - Start by tightening the lower left hex screw then move to the upper right. Continue the process by tightening the upper left hex screw then move to the lower right.

Installation

1. Position the 5diff syringe assembly back inside the instrument. Make sure the channel on the back of the assembly housing fits securely on the motor housing guide. Use a 3 mm Allen wrench.
2. Replace the two hex screws that secure the 5diff syringe assembly to the instrument.
3. At the 5diff syringe assembly, attach the two tubings associated with the flow cell (Figure 4.29-1):
    a. Connect the loose tubing near the top of assembly to port 1 (upper left port).
    b. Connect the loose tubing near the bottom of the assembly to port 5 (lower right port).
4. Attach the other three tubings at the 11-valve assembly (Figure 4.29-2):
    a. Connect the tubing (with a collar) that is attached to the upper middle port (port 2) on the 5diff syringe assembly to valve 3, port 3.
    b. Connect the tubing that is attached to the upper right port (port 3) on the 5diff syringe assembly to valve 5, port 1.
    c. Connect the tubing that is attached to the lower left port (port 4) on the 5diff syringe assembly to valve 2, port 2.

Verification

1. Reconnect the power cord.
2. Turn the instrument on. An automatic startup and background check is performed.
3. When the startup routine and background check are done, verify the 5diff syringe is not leaking.
4. If no leaks are detected, close the Main card door and reattach the left side door.
5. Perform a system verification. See Heading 5.3, SYSTEM VERIFICATION PROCEDURES.

4.30 FLOW CELL COAXIAL CABLE REPLACEMENT

Purpose

Use this procedure to replace the flow cell coaxial cable located inside the optical bench.

Tools/Supplies Needed

- ☐ Allen wrench, 3 mm
- ☐ Small Phillips-head screwdriver
- ☐ Lint-free tissues
- ☐ DIFF flow cell coaxial cable, PN - XBA399A

Preparation

1. Turn the instrument off and unplug the power cord from the instrument or the wall.
2. Remove the left side panel and top cover from the instrument. For details, see Heading 4.2. Set the top cover and left side panel aside.

CAUTION A flat cable is connected to the rear of the Main card. Be careful when you open the door (where the Main card is attached) that you do not disconnect or damage this cable.

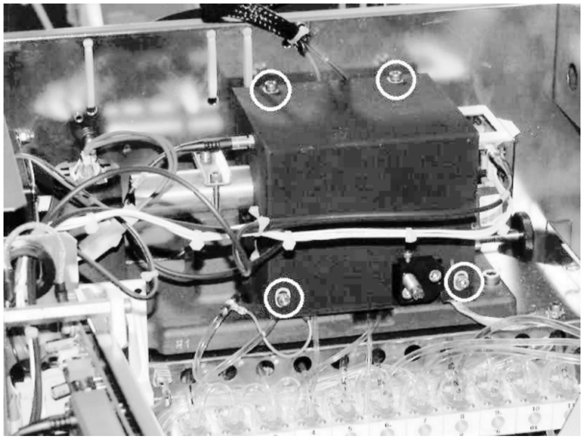
---

3. In the left side compartment,
   a. Turn the two captive knobs counterclockwise to release the Main card door. These knobs are located to the right of the Main card.
   b. Open the Main card door and carefully anchor the door behind the white plastic catch to keep it open. The optical bench is exposed.

Removal

1. Remove the four screws securing the optical bench cover (Figure 4.30-1).

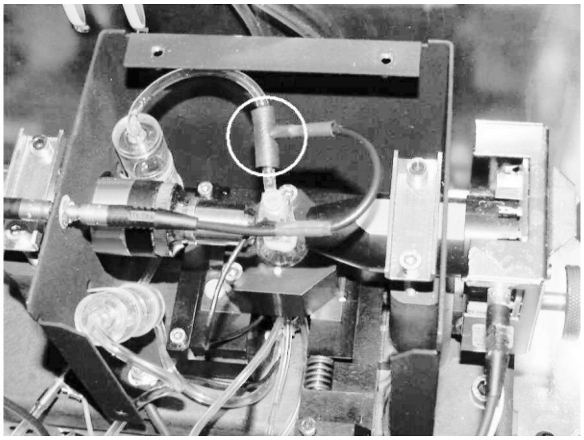
Figure 4.30-1 Optical Bench Cover Screw Locations



2. Locate the T-connector inside the optical bench (Figure 4.30-2).

   Note: Take time to examine the T-connector and its attachments. Notice a cable is inserted in the base of the T-connector. The top of the T-connector links two liquid tubings - the tubing from the isolator chamber and the tubing to the flow cell.

Figure 4.30-2 T-Connector Location

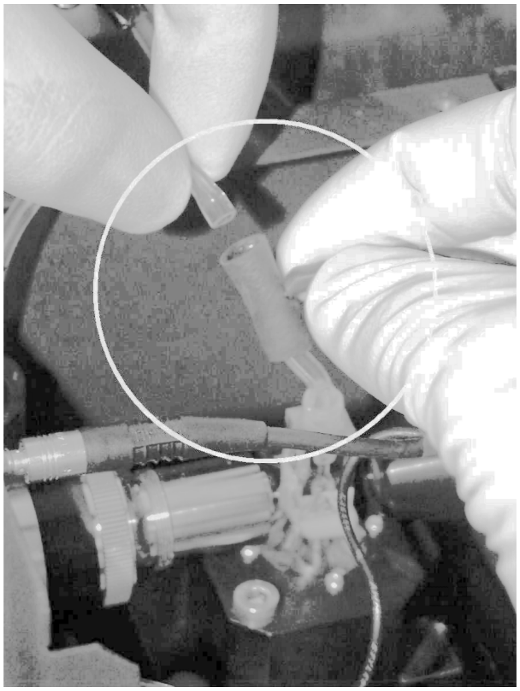


IMPORTANT Risk of compromising results if liquid splashes on the surface of the flow cell. Wet or dried liquid on the flow cell can affect output. Do not allow liquid to splash on the surface of the flow cell.

---

3. While holding a few lint-free tissues under the T-connector, disconnect the tubing coming from the isolator chamber (Figure 4.30-3). A few diluent drops will leak out.
4. Verify the sleeving is still attached to the tubing. If not, remove the sleeving from the T-connector and place it back on the tubing. This sleeve is needed to prevent leakage.

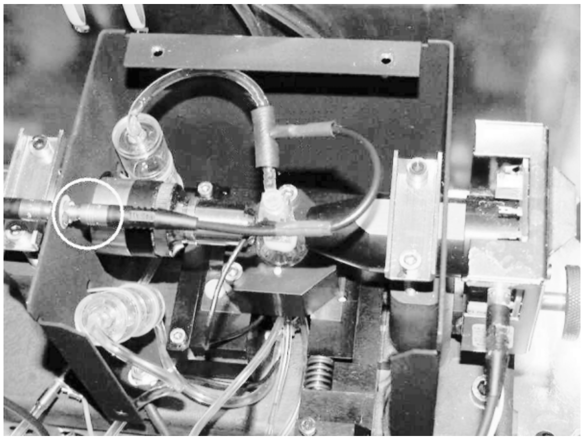
Figure 4.30-3 Disconnecting the Isolator Chamber from the T-connector



ATTENTION: Do not remove the tubing directly attached to the flow cell.

5. On the other side of the T-connector (at the T-connector, not the flow cell), disconnect the tubing going to the flow cell.
6. Verify the sleeving is still attached to the tubing. If not, remove the sleeving from the T-connector and place it back on the tubing. This sleeve is needed to prevent leakage.
7. Disconnect the coaxial cable from the coaxial connector on the optical bench housing.

Figure 4.30-4 Coaxial Cable Connector - Top View

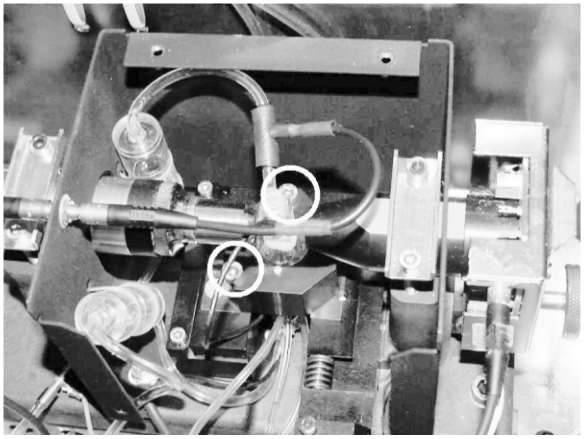


IMPORTANT Risk of compromising results if the flow cell surface is smudged. Fingerprints or other smudges on the flow cell can affect output. Do not touch the surface of the flow cell. Handle the black mount only when moving the flow cell.

---

8. Disconnect the ground fitting under the flow cell as follows:
    a. Locate and remove the two screws shown in Figure 4.30-5. Use a 3 mm Allen wrench.

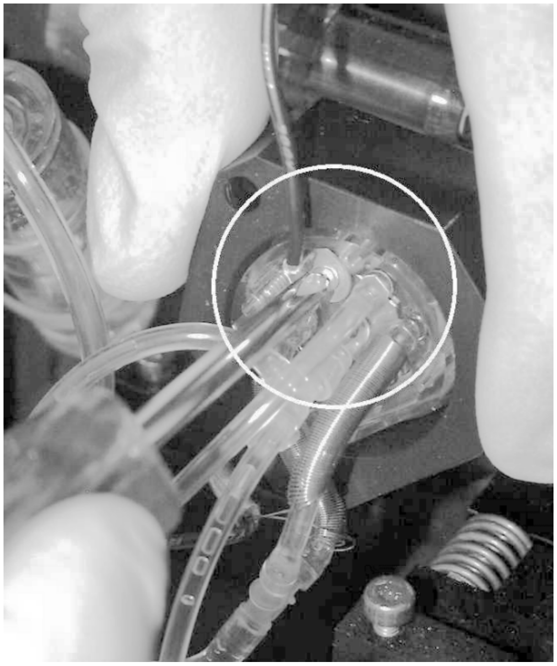
Figure 4.30-5 Flow Cell Screw Locations - Top View



    b. Using care not to touch the surface of the flow cell, slide the flow cell forward to separate it from its mount.
    c. Turn the flow cell slowly. Make sure the plastic shims remain in the instrument.

   d. Remove the ground screw using a small Phillips-head screwdriver (Figure 4.30-6).

Figure 4.30-6 Ground Screw Removal



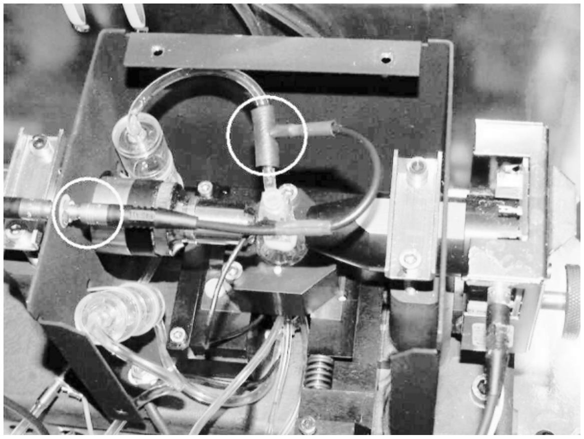
Replacement

1. Connect the ground ring on the new DIFF coaxial cable to the flow cell as follows:
   a. Position the ground ring on the bottom of the flow cell assembly and secure with the screw removed earlier. Use a small Phillips-head screwdriver (Figure 4.30-6).
   b. Turn the flow cell slowly and slide it inside its housing.
   c. Install the two screws that secure the flow cell to the optical bench (Figure 4.30-5). Use a 3 mm Allen wrench.
2. Attach the coaxial cable to the coaxial connector on the optical bench housing (Figure 4.30-7).
3. Attach the new DIFF coaxial cable, at the T-connector (Figure 4.30-7):

   Note: These tubings are sleeved to prevent leakage.

   a. Insert the tubing and sleeve from the isolator chamber into one leg of the T-connector.
   b. Insert the tubing and sleeve from the flow cell into the other leg of the T-connector.

Figure 4.30-7 Connector Location - Top View



4. Reconnect the power cord.
5. Turn the instrument on. An automatic Startup and background check is performed.
6. When the Startup routine and background check are done, press **ESC** to display the Main Menu.
7. From the Main Menu, select **4. DIAGNOSTICS** ▸▸ **3. DILUTER SYSTEMS** ▸▸ **2. RINSE** ▸▸ **2. FLOWCELL** to get rid of the air bubbles stuck to the inner optical surfaces.
8. When the flow cell routine is done, verify there are no leaks and that the flow cell contains no (or just a very few) air bubbles.
9. Replace the optical bench cover (Figure 4.30-1).

Verification

Go to Heading 4.4 and do a flow cell adjustment check. If an adjustment value is outside the acceptable range, do the corresponding adjustment.

4.31 OPTICAL BENCH LAMP REPLACEMENT

Purpose

Use this procedure to replace the optical bench lamp when the flow cell lamp fails.

Tools/Supplies Needed

☐ Allen wrenches, 3 mm, 2.5 mm, 2 mm
☐ Optical bench lamp. PN - DAJ007A

Preparation

1. Turn the instrument off and unplug the power cord from the instrument or the wall.
2. Remove the left side panel and top cover from the instrument. For details, see Heading 4.2. Set the left side panel and top cover aside.

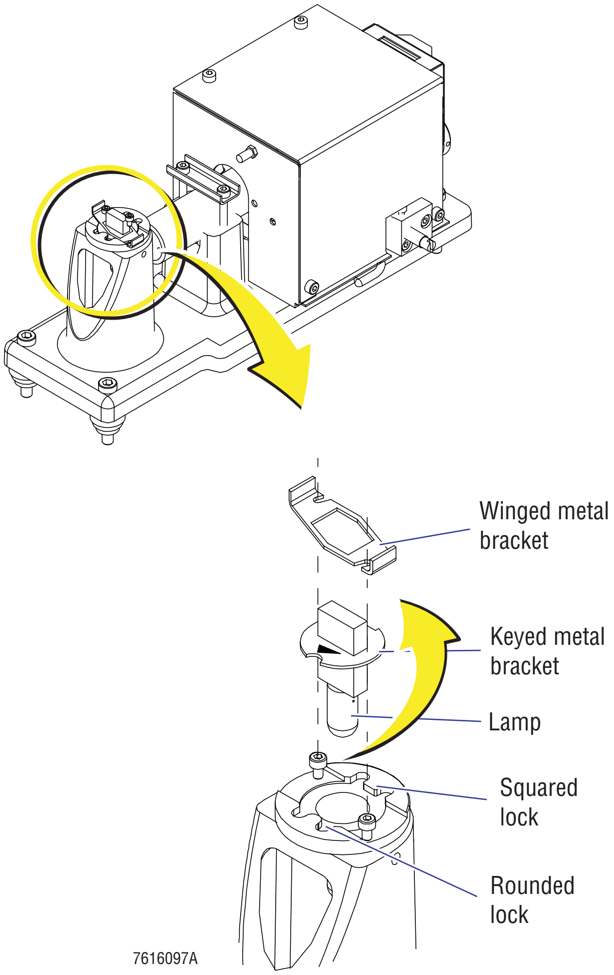
CAUTION A flat cable is connected to the rear of the Main card. Be careful when you open the door (where the Main card is attached) that you do not disconnect or damage this cable.

3. In the left side compartment,
   a. Turn the two captive knobs counterclockwise to release the Main card door. These knobs are located to the right of the Main card.
   b. Open the Main card door and carefully anchor the door behind the white plastic catch to keep it open. The optical bench is exposed.

WARNING Risk of personal injury due to hot surfaces within the instrument. Use care when working in this area. The lamp and some of the surfaces may be very hot and can burn you.

4. At the rear of the optical bench assembly (as view from the front of the instrument), locate the existing lamp and examine how it is seated. Figure 4.31-1 shows an exploded view of the assembly.

Figure 4.31-1 Optical Bench Lamp Assembly


Winged metal bracket
Keyed metal bracket
Lamp
Squared lock
Rounded lock
7616097A

5. Notice the positioning of the two metal brackets (Figure 4.31-1):
    - The top metal “winged” bracket is secured underneath a screw near each end.
    - The bottom metal bracket, which is part of the lamp, is keyed to ensure proper positioning of the lamp. Note the two different notches:
        - One notch is a semicircle that matches the rounded raised area (lock) on the housing.
        - On the opposite side is a squared notch that matches a squared raised area (lock) on the housing.

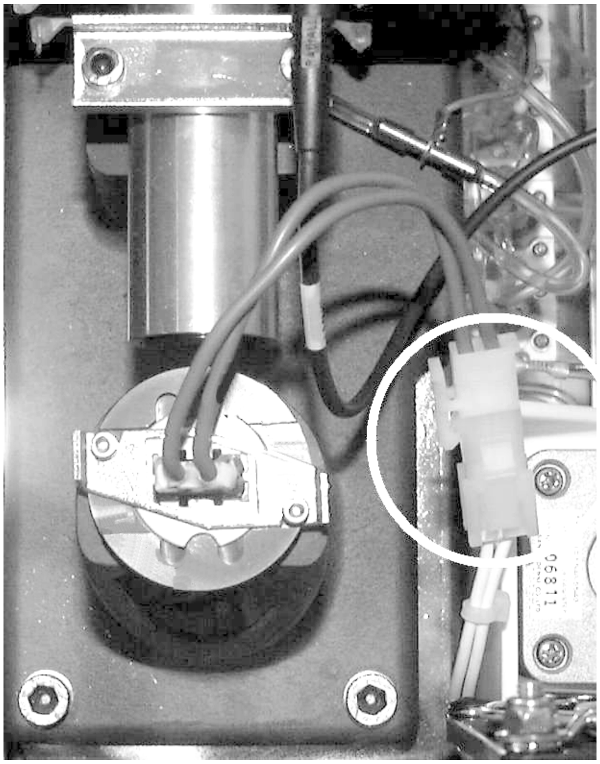
Removal

WARNING Risk of personal injury due to hot surfaces within the instrument. Use care when working in this area. The lamp and some of the surfaces may be very hot and can burn you.

---

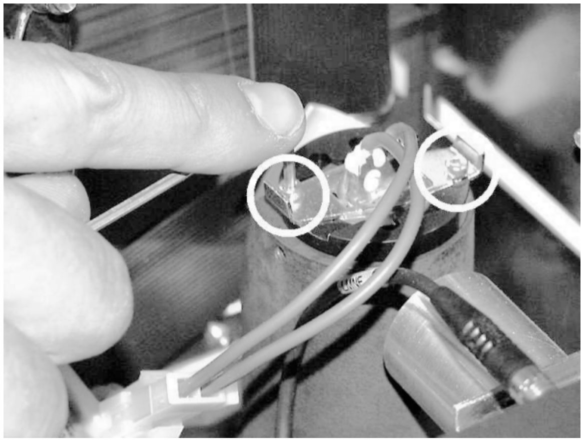
1. At the power connector, disconnect the lamp from the power supply (Figure 4.31-2).

Figure 4.31-2 Power Connector Location - Top View



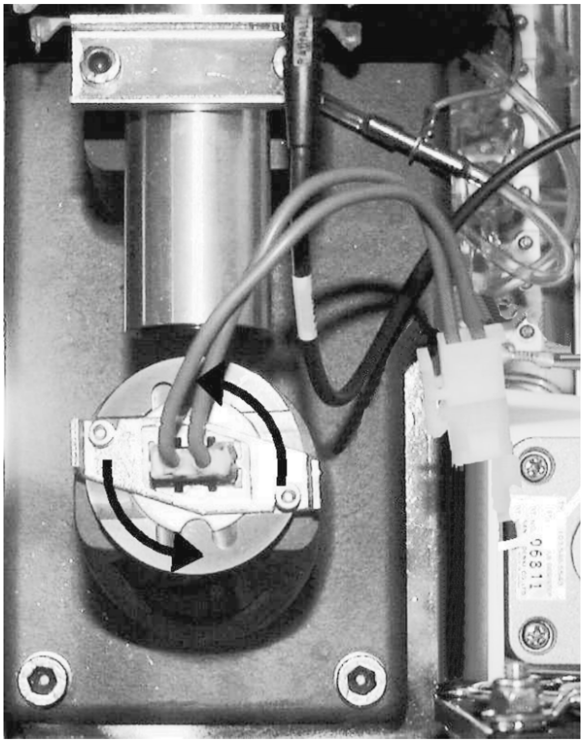
2. At the top of the lamp housing, loosen the two screws a few turns (Figure 4.31-3). It is not necessary to remove the screws. Use a 2 mm hex key.

Figure 4.31-3 Screw Locations - Lamp Housing



3. Turn the winged metal bracket counterclockwise to unlock the lamp (Figure 4.31-4).

Figure 4.31-4 Winged Metal Bracket - Top View



4. Lift the lamp and the bracket out of the housing.
5. Separate the winged metal bracket from the lamp and cable assembly.
6. Save the winged metal bracket. Discard the old lamp assembly.

Lamp Replacement

IMPORTANT Risk of compromising output of the new lamp if the surface is smudged. Fingerprints or other smudges on the lamp can affect output. Do not touch the surface of the lamp.

---

1. Using care not to touch the surface of the new lamp, place the old winged metal bracket over the new lamp.
2. Using the notches on the new lamp as a guide, position the new lamp assembly inside the housing. When the positioning is correct, each notch fits snugly against its raised area - like a lock and key.
3. Turn the winged metal bracket clockwise until it is seated under the two screws.
4. Tighten the two screws (Figure 4.31-3).
5. Reconnect the lamp to the Power Supply (Figure 4.31-2).

Verification

1. Reconnect the power cord.
2. Close the right side door.
3. Turn the instrument on.
4. While the instrument is performing a Startup and background check, verify the new lamp is lighted.
5. When the Startup routine and background check are done, replace all covers and close all doors.
    a. Gently close the Main card door. Turn the two captive knobs clockwise to secure the door.
    b. Replace the top cover and install the five hex screws that secure it to the instrument frame. See Heading 4.2 as needed.

    ATTENTION: When replacing the left side panel with the instrument powered on, avoid accidently turning the instrument off again by carefully positioning the opening for the power on/off rocker switch over the switch as you position the panel on the instrument frame.

    c. Replace the left side panel and install the four hex screws that secure it to the instrument frame.
    d. Close the right side door.
6. Perform a system verification. See Heading 5.3, SYSTEM VERIFICATION PROCEDURES

4.32 DILUENT RESERVOIR REPLACEMENTS

Purpose

Use this procedure to replace the O-ring and washer in the diluent reservoir. When performing this procedure to replace an O-ring or washer, replace both.

Tools/Supplies Needed

☐ Allen wrench, 3 mm

☐ Torque screwdriver, 2.5 mm hex-ball

Note: 120 mN.m (17.0 ozf.in) torque is required in this procedure.

☐ O-ring and washer, PN - XEA286AS

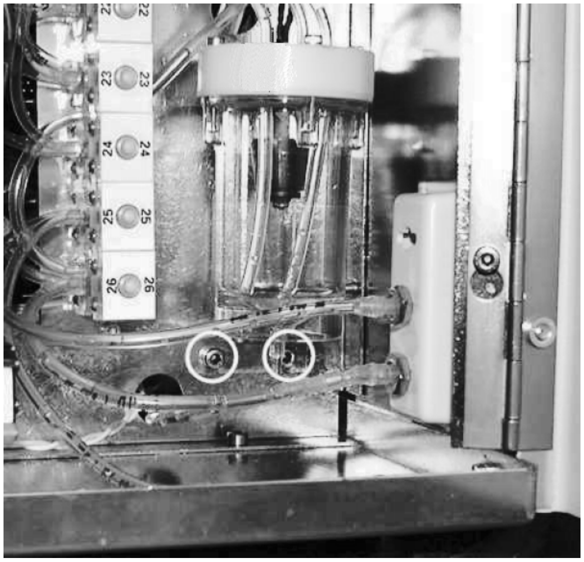
Preparation

1. If off, turn the instrument on.
2. From the Main Menu, select **4. DIAGNOSTICS ▸▸ 3. DILUTER SYSTEMS ▸▸ 3. DRAIN BATHS ▸▸ 7. DILUENT RESERVOIR.**
3. When the cycle is finished, open the right side door and verify the diluent reservoir is empty.
4. Turn the instrument off.

Removal

1. Locate the tubing attached to the bottom fitting under the reservoir tank. Trace this tubing to its connection point on solenoid valve 25. Remove the tubing from LV25, port 1.
2. Loosen the two screws under the diluent reservoir (Figure 4.32-1). It only takes a few turns to release the diluent reservoir from its support. Use a 3.0 mm Allen key.

Figure 4.32-1 Diluent Reservoir Screw Locations

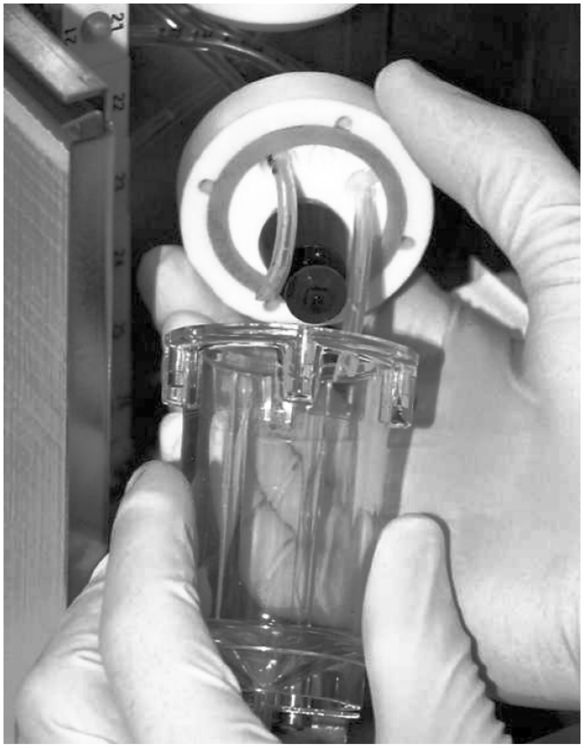


3. Carefully remove the reservoir and bottom bracket. Be careful that no other tubings disconnect from the reservoir.

O-ring and Washer Replacement

1. Remove the four screws on top of the cap using a 2.5 mm Allen wrench then remove the cap.
2. Remove and discard the old O-ring and washer.
3. Clean then dry the cap and the reservior.
4. Locate the replacement O-ring and washer.
5. Use a small amount of silicone grease between two fingers to lubricate the O-ring.
6. Place the new washer and O-ring securely inside the reservior cap (Figure 4.32-2).

Figure 4.32-2 Diluent Reservoir O-ring and Washer Positioning



7. Position the cap back on the reservoir body with the interior support connection turned towards the inside of the instrument and the extended tubings in the front (Figure 4.32-2).
8. When the cap is in position, place the four reservoir screws back in the cap then loosely tighten the four screws.

ATTENTION: Torque needed for the four hex screws (CHC M3x20) is 120 mN.m (17.0 ozf.in).

9. Tighten the four hex screws to secure the cap to the reservoir. Use a 2.5 mm hex-ball torque screwdriver to tighten the screws to 120 mN.m (17.0 ozf.in).

Installation

1. Position the diluent reservoir and bracket back in its original location.
2. Tighten the two hex screws that attach the reservior to its support (Figure 4.32-1).
3. Reattach the drain tubing under the diluent reservoir to solenoid valve 25, port 1.

Verification

1. Reconnect the power cord.
2. Close the right side door.
3. Turn the instrument on. An automatic startup and background check is performed.
4. When the startup routine and background check are done, verify the diluent reservoir is not leaking.
5. If no leaks are detected, perform a system verification. See Heading 5.3, SYSTEM VERIFICATION PROCEDURES.

4.33 SAMPLE SYRINGE ASSEMBLY REPLACEMENTS

Purpose

Use this procedure to remove and replace the two O-rings on the injector piston of the sample syringe.

Tools/Supplies Needed

- ☐ Allen wrench, 3 mm
- ☐ Torque screwdriver, T10 torx

  Note: 400 mN.m (56.8 ozf.in) torque is required in this procedure.
- ☐ Absorbent paper towels
- ☐ Replacement parts: O-ring, FAA064A (need 2)

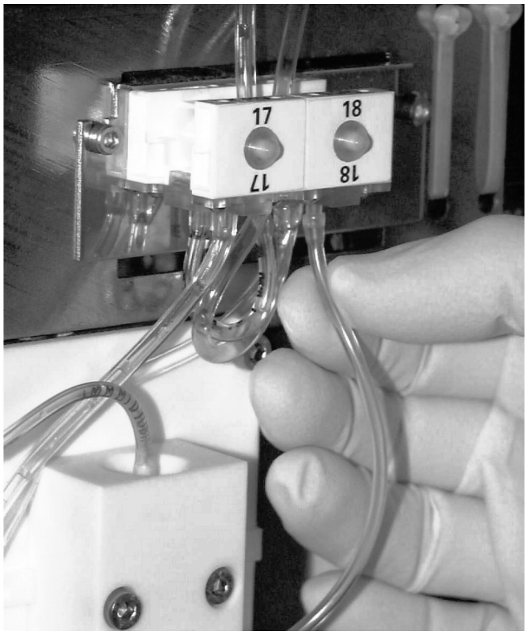
Preparation

1. If off, turn the instrument on.
2. From the Service menu, select **9. OTHERS ▸▸ 3. PARK SYRINGES**.
3. Turn the instrument off.
4. Open the right side door.

Removal

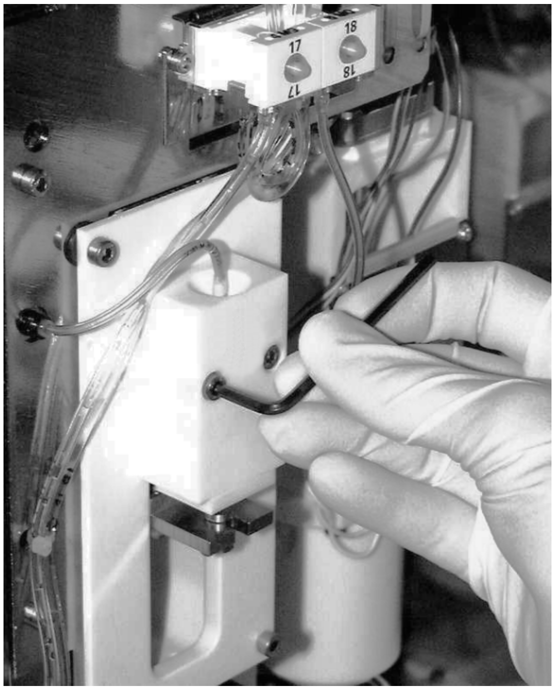
1. Manually push the sample probe housing towards the rear of the instrument until the sample probe is positioned over the rinse chamber.
2. Disconnect the tubing at solenoid valve 18, port 2 (Figure 4.33-1). The diluent drains through the sample syringe into the rinse chamber.

Figure 4.33-1 Disconnect Tubing at Valve 18, Port 2



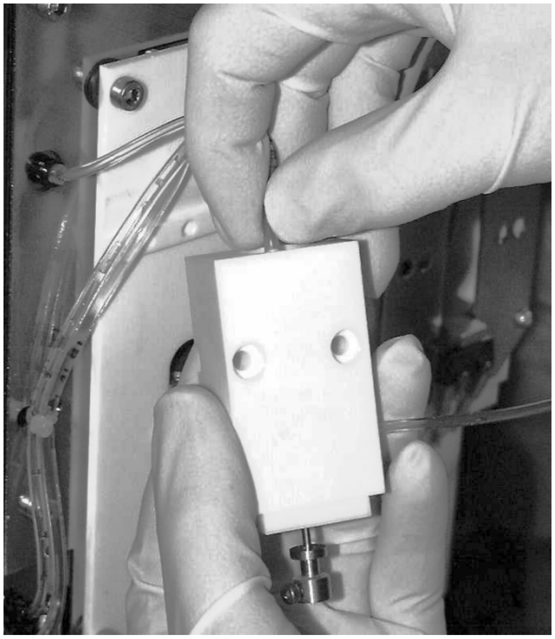
3. Remove the two hex screws securing the sample syringe housing to the instrument frame (Figure 4.33-2). Use a 3 mm Allen wrench.

Figure 4.33-2 Screw Locations - Sample Syringe Housing



4. Disconnect the tubing attached to the syringe output port (Figure 4.33-3). The other end of this tubing is connected to the top port of the sample probe.

Figure 4.33-3 Sample Syringe Output Port

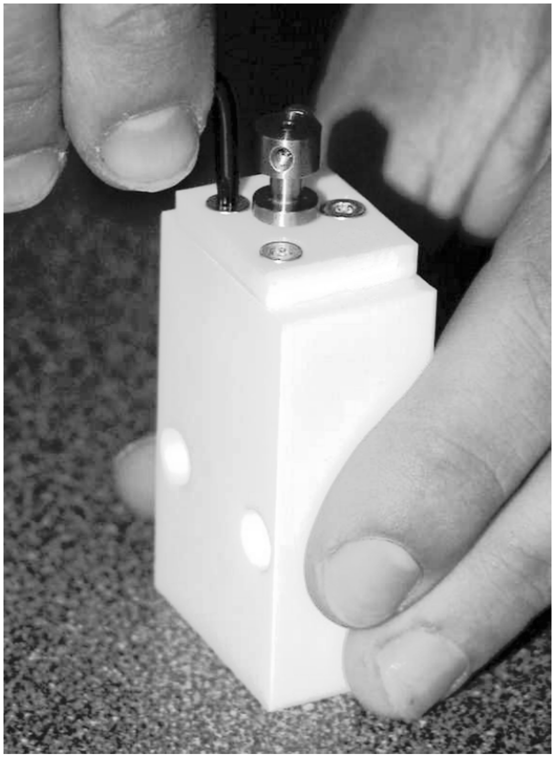


5. Remove the housing from the instrument and place it on absorbent paper towels.

O-ring Replacements

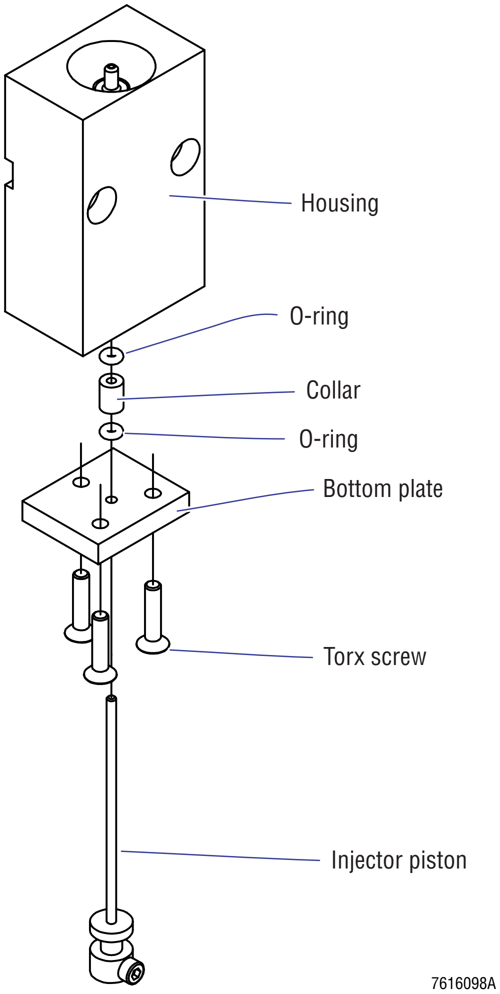
1. At the bottom plate, remove the three torx screws (FX M3x12) using a T10 Torx screwdriver (Figure 4.33-4).

Figure 4.33-4 Screw Locations on the Bottom of the Sample Syringe Housing



2. Separate the bottom plate (and attachments) from the sample syringe housing.
3. Clean then dry the outside of the sample syringe.
4. Replace the O-rings on the injector piston (Figure 4.33-5):
    a. Remove the two O-rings and the collar from the injector piston.
    b. Discard the old O-rings. Save the collar.
    c. Clean the outside of the injector piston and the bottom plate.
    d. Locate the two replacement O-rings.
    e. Use a small amount of silicone grease between two fingers to lubricate an O-ring then place it on the injector piston.
    f. Place the collar on the injector piston.
    g. Use a small amount of silicone grease between two fingers to lubricate another O-ring then place it on the injector piston.

Figure 4.33-5 Illustrated Parts - Sample Syringe



5. Once the replacements are complete, replace the bottom plate as follows:
   a. Carefully replace the bottom plate.
   b. Loosely install the three torx screws (Figure 4.33-4).

   ATTENTION: Torque needed for the three torx screws is 400 mN.m (56.8 ozf.in).

   c. Tighten the three torx screws. Use a torx driver with a T10 torx bit to tighten the screws to 400 mN.m (56.8 ozf.in).

Installation

1. Position the sample syringe back inside the instrument.
2. Replace the two hex screws that secure the sample syringe to the instrument (Figure 4.33-2).
3. Reattach the tubing connected at the top of the sample probe to the output port on the top of the syringe housing.
4. Reattach the tubing connected at the side of the sample syringe to solenoid valve 18, port 2.

Verification

1. Reconnect the power cord.
2. Close the right side door.
3. Turn the instrument on. An automatic startup and background check is performed.
4. When the startup routine and background check are done, verify the sample syringe is not leaking.
5. If no leaks are detected, perform a system verification. See Heading 5.3, SYSTEM VERIFICATION PROCEDURES.

4.34 DRAINING BATH REPLACEMENTS

Purpose

Use this procedure to replace the O-rings on the draining baths.

Tools/Supplies Needed

- ☐ O-ring, FAA066A (one for each bath)

Preparation

1. If off, turn the instrument on.
2. From the Main Menu, select **4. DIAGNOSTICS ▸▸ DILUTER SYSTEMS ▸▸ 3. DRAIN BATHS ▸▸ 6. ALL BATHS**.
3. Open the right side door.
4. Verify all the draining baths are empty.
5. Turn the instrument off.

O-ring Replacements

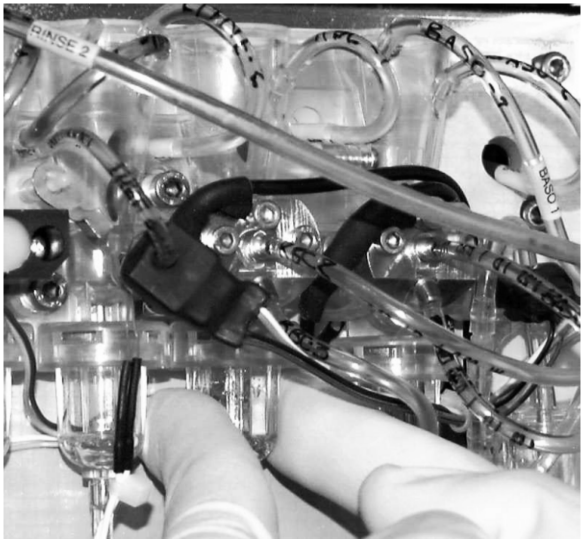
1. Locate the replacement O-rings.

WARNING Risk of personal contamination. If you do not properly shield yourself while servicing the drains baths, you may become contaminated. To prevent possible biological contamination, you must wear appropriate safety glasses, a lab coat, and gloves when servicing the drain baths.

ATTENTION: When removing a draining bath, the diffuser (which resembles a three-leg stool) may pop out of the bath. If this happens, the diffuser must be retrieved, rinsed with distilled water, and placed back inside the draining bath.

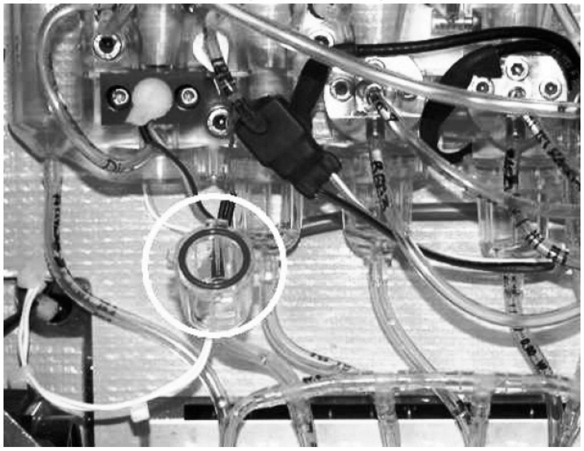
2. Grasp the bottom of the drain bath between two fingers and gently turn the bath to loosen then remove it from its support (Figure 4.34-1).

Figure 4.34-1 Removing a Draining Bath



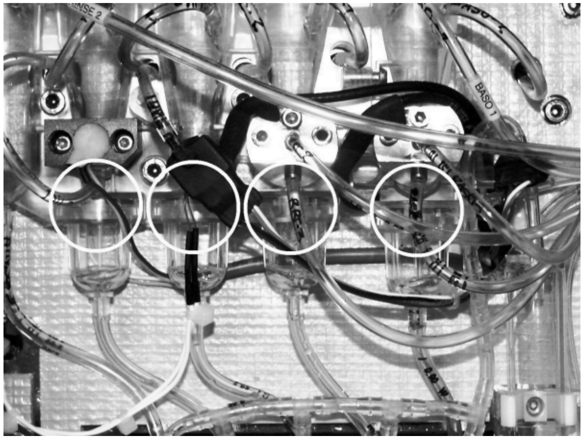
3. Remove and discard the old O-ring (Figure 4.34-2).
4. Clean then dry the top of the bath.
5. Make sure the diffuser is seated properly inside the draining bath. The circular part of the diffuser must rest on the bottom of the draining bath with the tabs extended upward. (Proper placement of diffuser resembles a three-legged stool turned upside down.)
6. Replace the O-ring (Figure 4.34-2)

Figure 4.34-2 Draining Bath O-ring Placement



7. Position the draining bath back on its support then gently rotate the bath to tighten it.
8. Repeat steps 2 through 7 at each draining bath (Figure 4.34-3).

Figure 4.34-3 Draining Bath O-Ring Locations



Verification

1. Close the right side door.
2. Turn the instrument on. An automatic startup and background check is performed.
3. When the startup routine and background check are done, verify the draining baths are not leaking.
4. If no leaks are detected, perform a system verification. See Heading 5.3, SYSTEM VERIFICATION PROCEDURES.

4.35 O-RING REPLACEMENTS IN THE COUNTING BATHS (RBC and WBC/BASO Baths)

Purpose

Use this procedure to replace the coaxial cable O-ring and the two counting head aperture O-rings. This procedure instructs you to bypass the right side door interlock which allows you to observe instrument operation with the right side door open. Avoid any unnecessary contact with the sample probe. The probe is sharp and may contain biohazardous materials. When the procedure is complete, make sure the interlock is reactivated to ensure the customer is not injured by the sample probe or its movement.

Tools/Supplies Needed

- ☐ Allen wrenches, 3 mm, 2.5 mm, 2 mm
- ☐ Torque screwdriver

  Note: 100 mN.m (14.2 Ozf.in) torque is required in this procedure.
- ☐ Hemostat or tweezers with a pointed end
- ☐ Small side cutters
- ☐ Protective cover for the bath electrode

  Note: If you do not already have this special tool, you will need a micropipette tip and a scalpel or sharp knife.
- ☐ White paper towel or cloth
- ☐ Cotton-tip applicator stick
- ☐ High quality, fragrance-free bleach (10-12% sodium hypochlorite - available chloride)
- ☐ Distilled water
- ☐ Replacement parts
  - Coaxial cable O-ring, PN - FAA046A (need 1 for each bath)
  - Aperture O-ring, PN - GBG156A (need 2 for each bath)

Preparation

1. Locate the replacement coaxial cable O-rings (one needed for each bath) and the aperture O-rings (two needed for each bath).
2. If off, turn the instrument on.
3. From the Service menu, bypass the right side door interlock:
   a. Select **9. OTHERS ▸▸ 1. USER MODE.**
   b. Press the down arrow key to highlight the *SERVICE* option.

      Note: This option bypasses the right side door interlock allowing you to observe instrument operation with the right side door open.
   c. Press the decimal point key then **ESC** to select the Service option.
   d. Press **ESC** two more times to return to the Diagnostics menu.
4. From the Diagnostics menu, select **3. DILUTER SYSTEMS ▸▸ 3. DRAIN BATHS ▸▸ 6. ALL BATHS**.
5. Open the right side door and verify all the baths are empty.
6. Turn the instrument off and disconnect the power cord.

7. Remove the left side panel and set it aside.

Removal

WARNING Risk of personal contamination. If you do not properly shield yourself while servicing the bath assembly, you may become contaminated. To prevent possible biological contamination, you must wear appropriate safety glasses, a lab coat, and gloves when servicing the bath assembly.

---

1. Before removing the baths assembly, position the sample probe to provide a rough alignment guide when the baths assembly is replaced at the end of this procedure.
   a. Manually push the sample probe housing over the rinse bath.
   b. Gently push down on the top of the sample probe until the tip of the probe rests on the inside rim of the rinse bath (Figures 4.35-1 and 4.35-2).

Figure 4.35-1 Sample Probe Position at the Rinse Bath

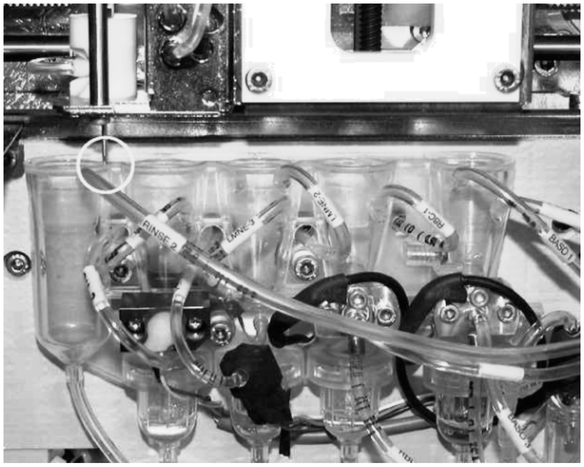
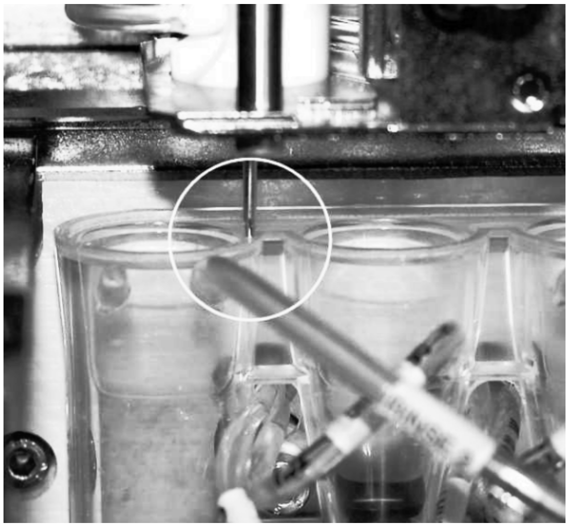
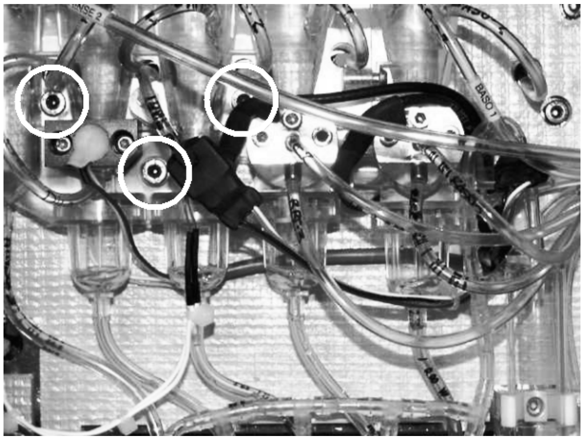


Figure 4.35-2 Close-up of Probe Positioning



   c. Without moving the probe position, manually push the sample probe as far forward as possible to the front of the instrument. At the end of this procedure, the positioning of this probe will provide a guide for aligning the baths assembly.
2. Place a piece of white paper or cloth under the baths assembly.
3. Record the tubing positions before dismantling the baths assembly.
4. Disconnect all bath tubings except the waste tubings.
5. Remove the three screws securing the baths assembly to the instrument panel (Figure 4.35-3). Use a 3 mm Allen wrench.

Figure 4.35-3 Baths Assembly Screw Locations

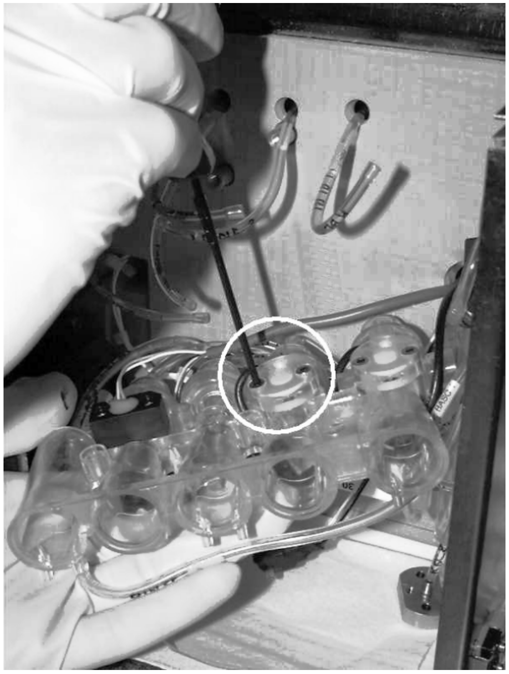


O-ring Replacements

Replacing the Coaxial Cable O-ring on the Bath Electrode

1. Loosen the two hex screws on the back of the RBC bath (Figure 4.35-4). Use a 2 mm Allen wrench.

Figure 4.35-4 Electrode Screw Locations



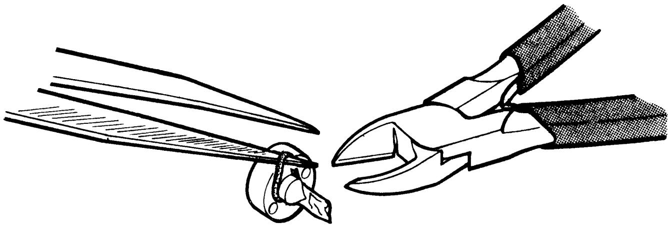
2. Carefully remove the electrode from the bath.

CAUTION Risk of damage to the bath electrode. When removing the coaxial cable O-ring, you can accidently cut the bath electrode. Make sure the O-ring is sufficiently clear of the electrode before cutting the O-ring.

---

3. Remove the coaxial cable O-ring from the bath electrode as follows (Figure 4.35-5):
   a. Use a small, pointed-tip tweezers to grasp the O-ring (Figure 4.35-5).
   b. While gently lifting the O-ring to separate it from the electrode, carefully cut the O-ring with a pair of small side cutters (Figure 4.35-5). Do not clip the electrode.

Figure 4.35-5 Removing the Coaxial Cable O-ring from the Bath Electrode

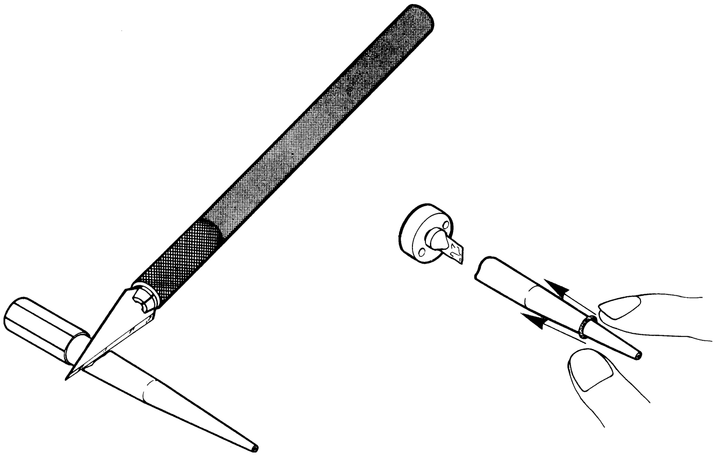


CAUTION Risk of damage to the bath electrode. When replacing the coaxial cable O-ring, you can accidently break off the bath electrode. Use a plastic micropipette tip (cut to fit over the electrode) to protect the bath electrode as you seat the O-ring.

---

4. If you have not already done so, use a plastic micropipette tip to make a protective cover for the bath electrode (Figure 4.35-6).
   - Use a scalpel or other sharp knife to cut the plastic micropipette tip.
   - Shorten the tip until it fits securely over the bath electrode.

Figure 4.35-6 Making a Protective Cover from a Micropipette Tip



5. Position the new O-ring over the bath electrode as follows:
   a. Place the coaxial cable O-ring on the protective cover (Figure 4.35-6).
   b. Carefully position the protective cover over the bath electrode.
   c. Push the O-ring from the plastic cover onto the bath electrode.
   d. .Carefully remove the plastic cover from the electrode. Make sure the O-ring remains on the bath electrode.
   e. Verify the O-ring is properly seated.

6. Set the bath electrode aside. While the bath is disassembled, replace the aperture O-rings in the counting head.

Replacing the Aperture O-rings in the Counting Head

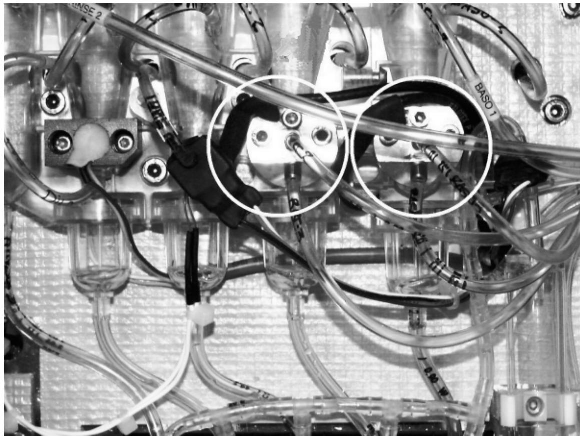
IMPORTANT Risk of misleading results. The 50 µm RBC/PLT aperture and the 80 µm WBC/BASO aperture are not interchangeable. Disassemble the RBC/PLT counting head, replace the aperture O-ring, and reassemble the counting head before disassembling the WBC/BASO counting head.

ATTENTION: Be careful when handling an aperture, it is very small so it is easy to drop and easy to lose. It is recommended that you work over a white surface so the aperture can be easily seen if it is dropped.

1. If you have not already done so, place a piece of white paper or cloth under the baths assembly.
2. Carefully dismantle the RBC/PLT counting head (Figure 4.35-7). Use a 2.5 mm Allen key.

   Note: In Figure 4.35-7, the RBC/PLT counting head is on the left and the WBC/BASO counting head is on the right.

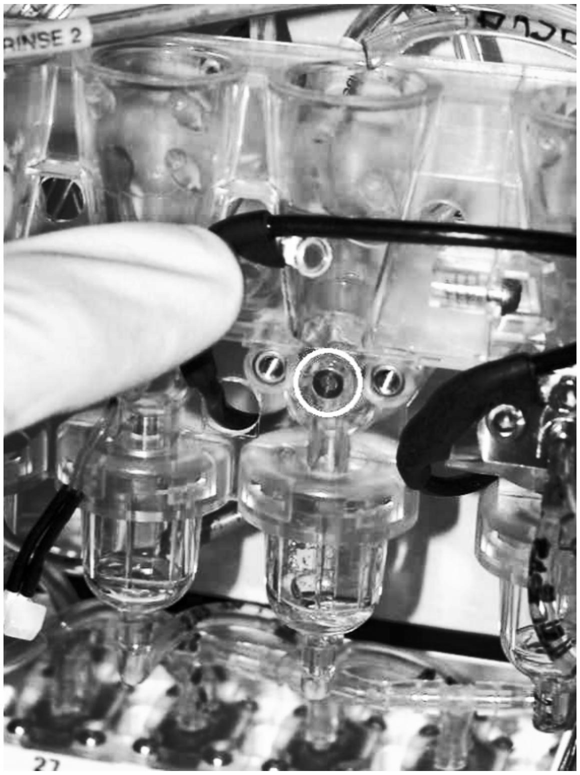
Figure 4.35-7 Bath Electrode Locations



3. When the counting head is separated from the bath, one of the O-rings may remain inside the counting head. If this happens, remove and discard the O-ring and clean the counting head.

4. Figure 4.35-8 shows the aperture and O-ring location on the bath when the counting head is removed.

Figure 4.35-8 Location of the Aperture and Its Two O-Rings



CAUTION Risk of damage to the bath or aperture. Using a sharp instrument inside the bath may damage the inside of the bath and the aperture. Never use a sharp instrument inside the bath.

---

5. Remove the aperture and the O-ring from the bath as follows:
   a. Locate a cotton-tip applicator stick.
   b. Hold the bath close to the surface of the white paper towel.
   c. Insert the cotton tip of the applicator stick through the opening created when the bath electrode was removed (at the rear of the baths assembly).
   d. Gently push the aperture and O-ring onto the white paper surface.
6. Place the aperture in a small amount of distilled water to keep it moist and discard the old O-ring(s).
7. Clean the bath and counting head as follows:
   a. Pour diluted bleach on a soft, clean paper towel.
   b. Clean the bath and the counting head using the wet paper towel.
   c. Rinse the surfaces thoroughly with distilled water.
   d. Dry the counting head and the exterior of the bath with a soft paper towel.

8. Install the new O-rings and replace old aperture as follows:

   Note: When completed, the aperture should be sandwiched between the two aperture O-rings.

   a. Moisten the tip of your finger with distilled water then pick up one of the aperture O-rings using your moistened finger.
   b. Pass your finger (with the clinging O-ring) across the bath opening to seat the O-ring in the groove.

CAUTION Risk of damage to the aperture. Do not handle the aperture using a hard instrument or tool. Handle the aperture with your fingers. Clean the aperture gently between your two fingers.

---

   c. Pick up the aperture with your finger tip then gently rub it between two fingers to clean it. Rinse the aperture with distilled water.
   d. Position the aperture on the tip of your moistened finger.
   e. Pass your finger (with the clinging aperture) across the bath opening to seat the aperture on the aperture O-ring already seated in the bath opening.
   f. Moisten the second aperture O-ring and seat it inside the counting head.

CAUTION Risk of damage to the aperture. If too much pressure is applied as the bath components are being reassembled, the aperture may break. To avoid applying too much pressure on the bath (and the aperture), reconnect the counting head tubing before attaching the counting head back on the bath.

---

9. Reconnect the counting head tubings.
10. Carefully position the counting head back on the bath. Make sure the O-rings and aperture are properly seated and do not become crimped as you position the counting head on the bath.
11. Loosely install the two hex screws in the counting head.

CAUTION Risk of damage to the aperture. Overtightening the counting head hex screws can break the aperture. Tighten these screws to a torque of 100mN.m (14.2 ozf.in) using a torque screwdriver with a 2.5 mm bit.

ATTENTION: Torque needed for the RBC (and WBC/BASO) bath hex screws is 100 mN.m (14.2 ozf.in).

12. Tighten the two counting head hex screws. Use a 2.5 mm torque screwdriver to tighten each screw to 100 nN.m (14.2 ozf.in).
13. Install the coaxial cable electrode that was set aside earlier:
    a. Carefully insert the bath electrode inside the opening at the rear of the bath.
    b. Loosely install the two hex screws.
    c. Tighten the two hex screws. Use a 2 mm torque screwdriver to tighten each screw to 100 nN.m (14.2 ozf.in).
14. Repeat steps 2 through 13 on the WBC/BASO counting head. See Figure 4.35-7. (The WBC/BASO counting head is the one on the right.)

Installation

1. Using your recorded tubing positions, reattach the bath tubings.
2. Being careful to not crimp any tubings, position the baths assembly against its support panel.
3. Replace and loosely tighten the three screws removed earlier (Figure 4.35-3).
4. Make sure any liquid inside the bath compartment is wiped dry, especially any liquid on the solenoid valves.

Align the Bath Assembly

CAUTION Risk of damage to the sample probe. If power is restored to the instrument and the baths assembly is mounted too high, the sample probe may become bent when it hits the bath edges as it moves from bath to bath. Do not restore instrument power until the baths assembly is aligned.

1. Manually push the sample probe housing to the outside edge of the rinse bath. Move the baths assembly up or down as necessary until the tip rests gently on the outside rim of the rinse bath.
2. While continuing to push the sample probe housing over the rinse bath to the inside edge of the bath, adjust the bath assembly up or down as needed so that the sample probe tip comes to rest gently on the inside rim of the rinse bath as shown in (Figures 4.35-9 and 4.35-10).

Figure 4.35-9 Sample Probe Position at the Rinse Bath

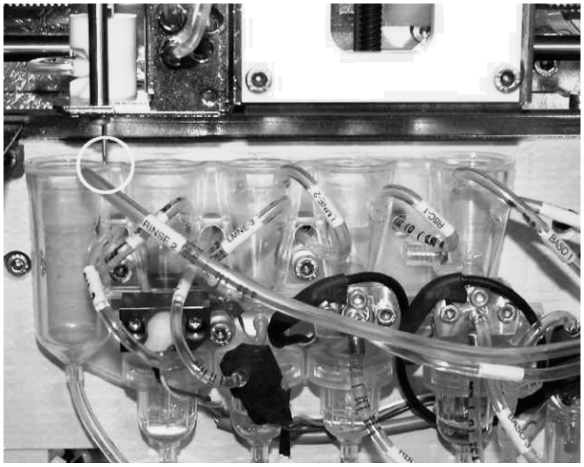
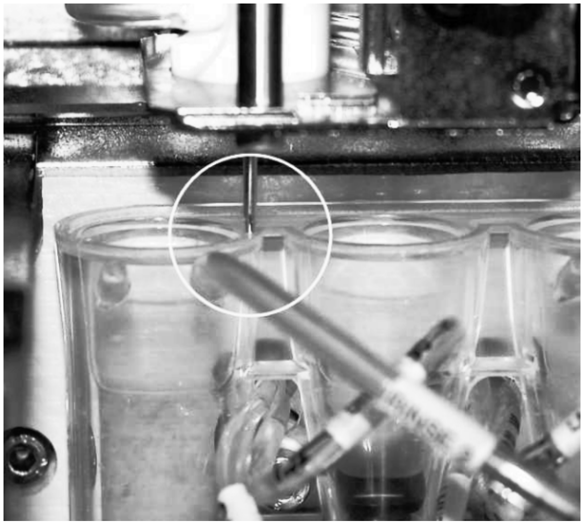


Figure 4.35-10 Close-up of Acceptable Probe Position



3. Gently tighten the center and left screws.
4. Without lifting the probe, gently push the probe housing towards the inside edge of the last bath, the WBC/BASO bath. Reposition the baths assembly as needed to clear the edge of each bath.

5. Verify the sample probe is positioned at the WBC/BASO bath as shown in Figures 4.35-11 and 4.35-12.

Figure 4.35-11 Sample Probe Position, Right Side

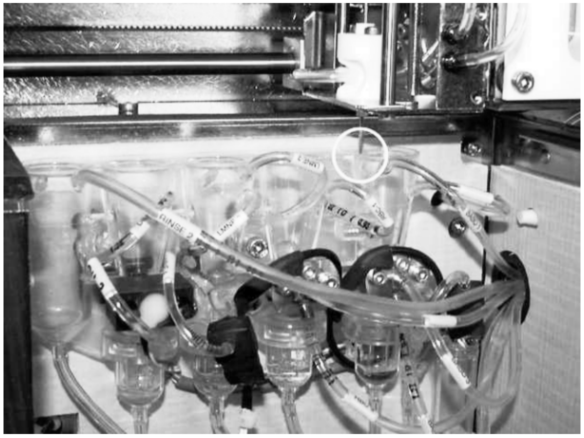
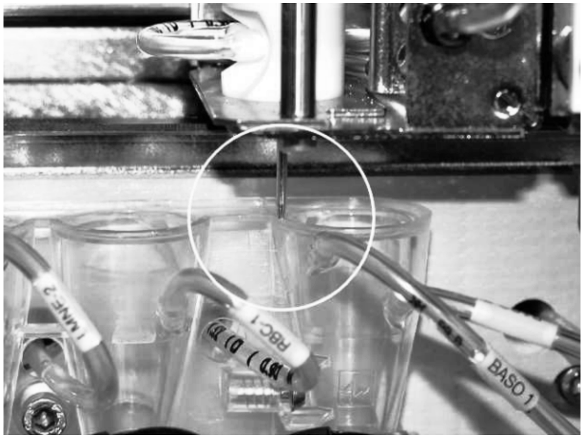


Figure 4.35-12 Close-up of Acceptable Probe Position



6. Gently tighten the right screw on the baths assembly.
7. Make sure all three screws are tight so that the baths assembly is secure on the instrument's frame.
8. Carefully move the sample probe housing over the outer edge of the rinse bath. The probe should equally clear all baths. If not, loosen the nearest screw and reposition the baths assembly until the distance between the tip of the probe and the top of each bath is the same.

Verification

1. Reconnect the power cord.
2. Turn the instrument on.

WARNING Risk of personal injury. The right side door interlock is bypassed which allows you to observe instrument operation with the right side door open. Avoid any unnecessary contact with the sample probe. The probe is sharp and may contain biohazardous materials. When the procedure is complete, make sure the interlock is reactivated to ensure the Customer is not accidently injured by the sample probe or its movement.

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3. On the instrument keypad, press the **STARTUP** button to initiate the startup cycles and background check.
4. As the startup routine and background check are being done,
   a. Observe operation inside the right side compartment to verify there are no leaks. Look at the entire compartment not just the baths assembly. If a tubing is connected to a wrong port, the liquid in that tubing will be sent to an area that is not meant to receive it.
   b. Check for leaks inside the left compartment.

5. From the Service menu, select **9. OTHERS ▸▸ 1. USER MODE** and reconnect the right side door interlock.
   a. Press the up arrow key to highlight the *MANUAL* option.
   b. Press the decimal point key then **ESC** to select the Manual option.
   c. Press **ESC** again to return to the Service menu.

CAUTION It is mandatory to perform the probe adjustment procedure after this adjustment.

6. Check the sample probe position inside each bath.
   - Under Heading 4.6, SAMPLE PROBE CHECKS AND ADJUSTMENTS, do the Inside Bath Position Check.
   - Perform the adjustment if needed.
7. When the probe position inside each bath is correct, perform a system verification. See Heading 5.3, SYSTEM VERIFICATION PROCEDURES.

4.36 OPTICAL BENCH PRELIMINARY ADJUSTMENTS

Purpose

Use this procedure to make preliminary adjustments to the flow cell and optics in the optical bench assembly. These adjustments may be necessary when the:

- Optical bench assembly is replaced.
- The flow cell is replaced.
- Transfer Time value is outside the acceptable range.
- Absorbance Channel value is outside the acceptable range.
- Optical lamp is replaced.

Tools/Supplies Needed

☐ Allen wrenches, 3 mm, 2 mm

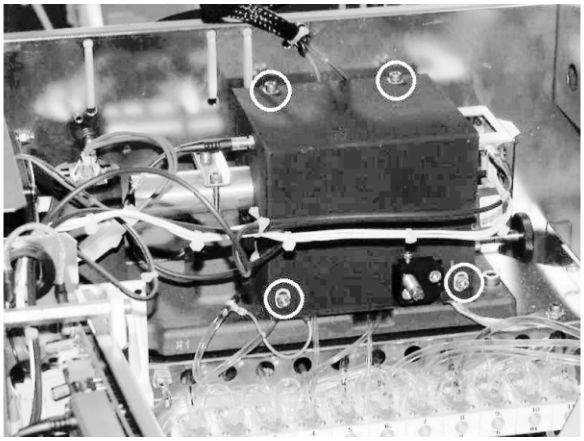
Preparation

1. Turn the instrument off and unplug the power cord from the instrument or the wall.
2. Remove the left side panel and the top cover from the instrument. For details, see Heading 4.2. Set the left side panel and top cover aside.

CAUTION A flat cable is connected to the rear of the Main card. Be careful when you open the door (where the Main card is attached) that you do not disconnect or damage this cable.

3. In the left side compartment,
   a. Turn the two captive knobs counterclockwise to release the Main card door. These knobs are located to the right of the Main card.
   b. Open the Main card door and carefully anchor the door behind the white plastic catch to keep it open. The optical bench is exposed.
4. At the optical bench,
   a. Remove the four hex screws shown in Figure 4.36-1.
   b. Carefully remove the optical bench cover and set it aside.

Figure 4.36-1 Optical Bench Cover Screw Locations



Verify the Flow Cell is Free of Bubbles

1. Turn the instrument on. An automatic startup and background check is performed.
2. From the Main Menu, select **4. DIAGNOSTICS ▸▸ 3. DILUTER SYSTEM ▸▸ 2. RINSE ▸▸ 2. FLOWCELL** to remove air bubbles clinging to the inner optical surfaces.
3. When the routine is complete, verify the flow cell is bubble-free. (An occasional air bubble is acceptable.)
4. Press **ESC** as many times as necessary to return to the Main Menu.

Course Adjustments

ATTENTION: Course adjustment of the flow cell positions the lens and flow cell system for final alignment with the Absorbance Channel adjustment. **Course adjustments may not be necessary.** If the Absorbance Channel value and the Transfer Time value are acceptable, course adjustments are not needed.

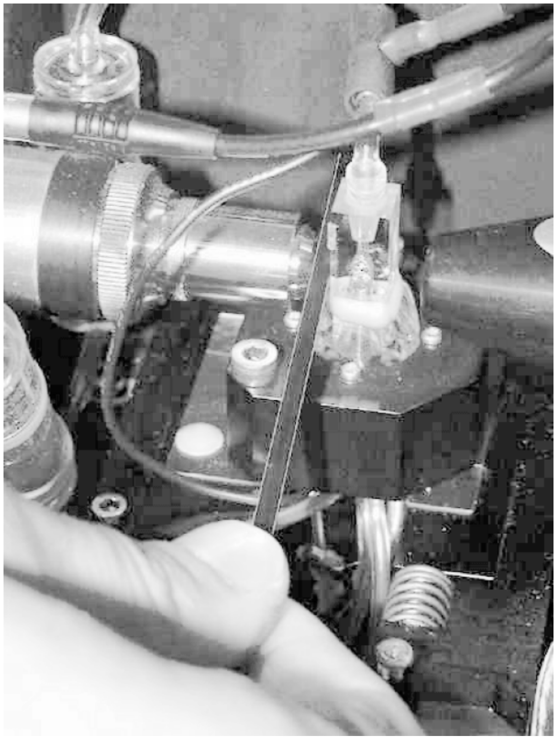
Y-Axis Adjustment

CAUTION Never dismantle the lens assembly or even unlock it. The adjustment is factory made and cannot be performed in the field.

CAUTION If you use a 3 mm Allen wrench to check the gap, be careful that you do not damage or scratch the flow cell or lens assembly.

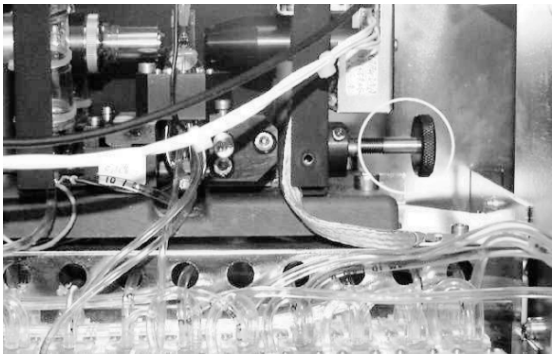
Use a 3 mm shim or Allen wrench to verify the gap between the lens assembly and the flow cell is approximately 3 mm (Figure 4.36-2). The final adjustment will be close to this position.

Figure 4.36-2 Checking the Lens to Flow Cell Gap



- If the gap is approximately 3 mm, go to the X-Axis Adjustment heading.
- If the gap is not close to 3 mm, use the front knob (Figure 4.36-3) to move the flow cell forward or backwards (along the Y-axis) as needed.

Figure 4.36-3 Front Knob for Y-Axis Adjustment

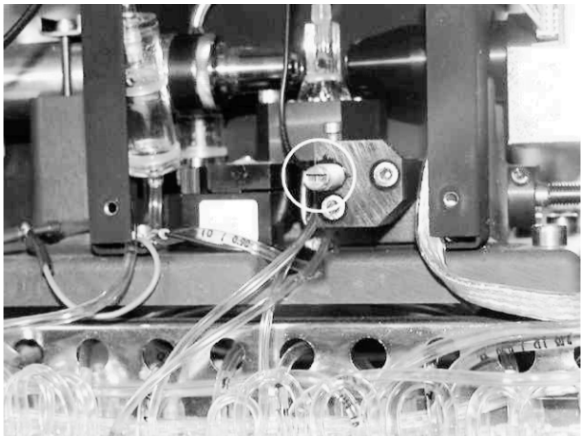


X-Axis Adjustment

The lens assembly is fixed. During this course adjustment, the flow cell is repositioned as needed along its X-axis so that the focal point of the light beam coming from the lens assembly is properly positioned inside the flow cell.

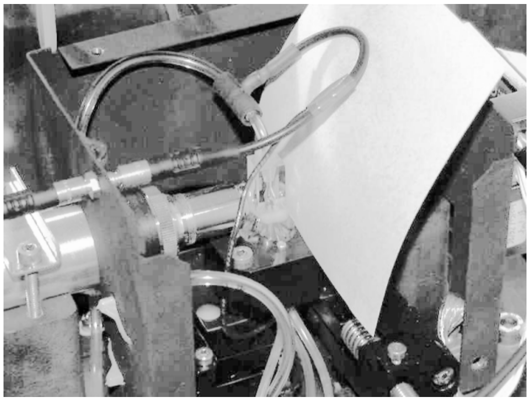
1. From the rear of the instrument, look down the lens assembly and evaluate the position of the flow cell in relation to the lens assembly. The flow cell must be centered with the lens.
2. If the flow cell is located to the left or to the right of the lens, use the side screw (Figure 4.36-4) to move the flow cell left or right (along the X-axis) so that the flow cell is roughly centered with the lens.

Figure 4.36-4 Side Screw - X-Axis Adjustment



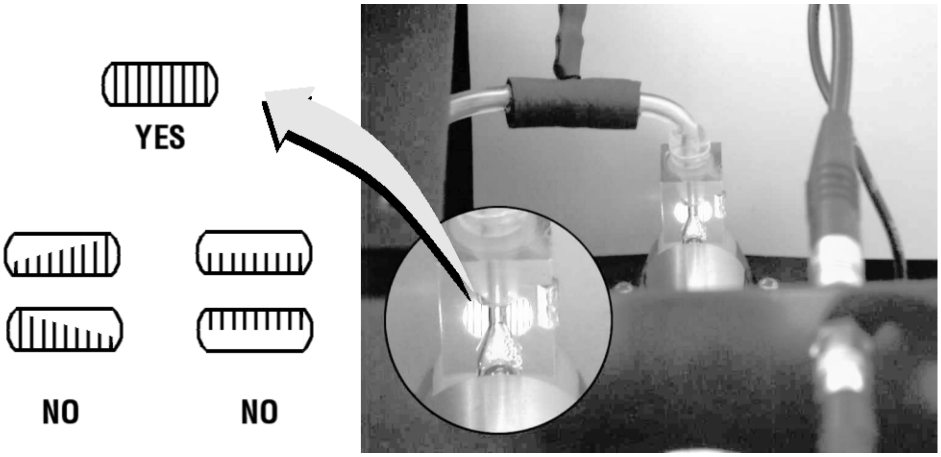
3. Place a piece of white paper between the flow cell and the reception diode as shown in Figure 4.36-5.

Figure 4.36-5 How to Position the White Paper



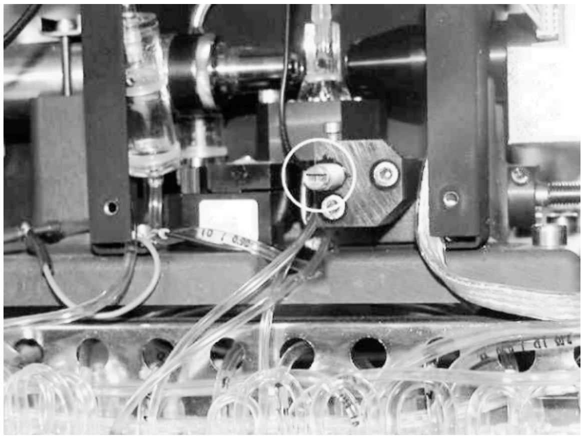
4. From the rear of the instrument, look for a light spot on the white paper.
   - If the lamp filament image on the white paper matches the ideal image seen in Figure 4.36-6, go to step 5.
   - If the image does not match the ideal projection seen in Figure 4.36-6, go to the Lamp Alignment heading that follows before proceeding.

Figure 4.36-6 Ideal Lamp Filament Projection Image



5. Use the side screw (Figure 4.36-7) to position the flow cell in the center of the light spot.

Figure 4.36-7 Side Screw - X-Axis Adjustment



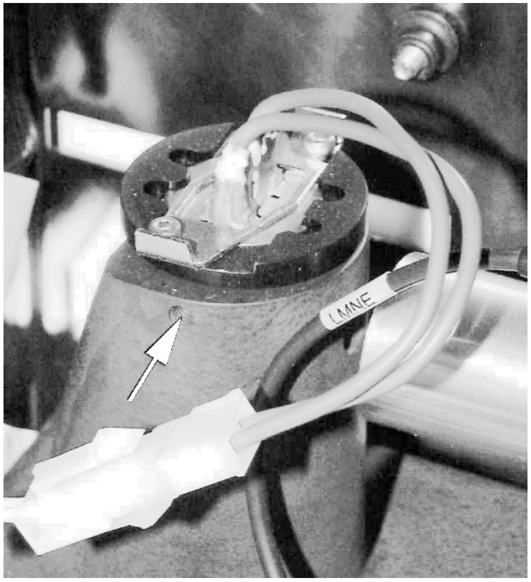
6. Go to Heading 4.4, FLOW CELL CHECKS AND ADJUSTMENTS to ensure the diff adjustment values are within acceptable limits.

Lamp Alignment

CAUTION A small 2 mm setscrew in the lamp housing allows adjustment of the optics lamp. This adjustment is factory made and should not be changed unless absolutely nececessary.

The optics lamp can be aligned using a 2 mm setscrew in the lamp housing (Figure 4.36-8). When this setscrew is loosened, the entire lamp, with its base, can be turned or moved up and down. Make this adjustment only if the previous flow cell adjustments did not produce a proper filament projection.

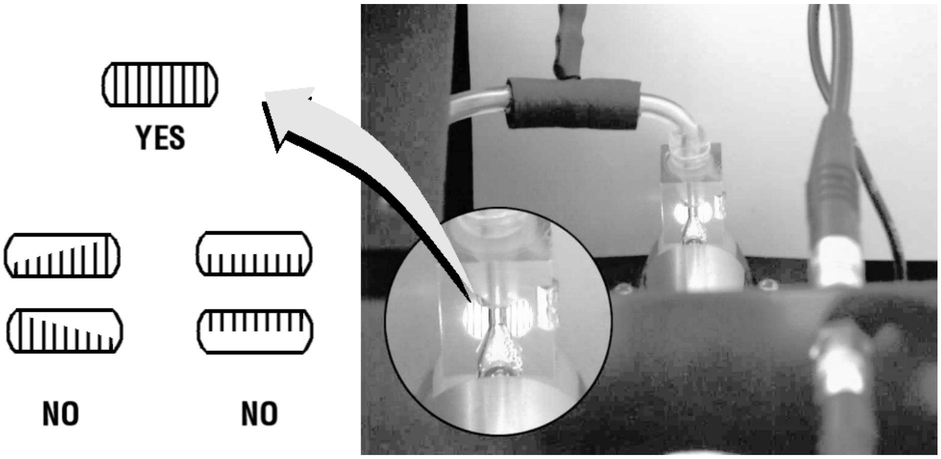
Figure 4.36-8 Lamp Adjustment Screw



1. Use a 2 mm Allen wrench to loosen the setscrew holding the lamp base in place (Figure 4.36-8). Do not remove the setscrew.

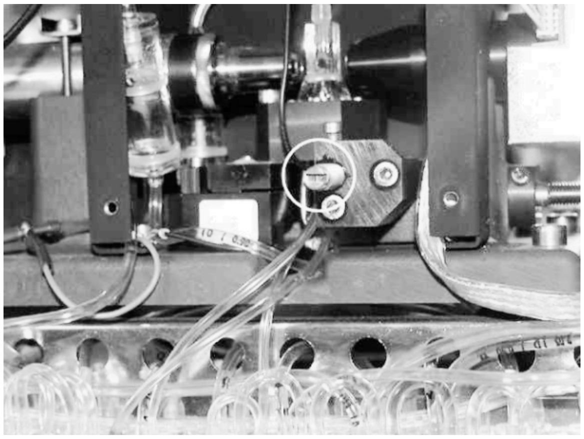
2. While rotating the entire lamp with its base, move the lamp up or down as needed until the lamp filament projection image matches the ideal projection image seen in Figure 4.36-9.

Figure 4.36-9 Ideal Lamp Filament Projection Image



3. When the light spot matches the image seen in Figure 4.36-9, tighten the setscrew.
4. Use the side screw (Figure 4.36-10) to position the flow cell in the center of the light spot.

Figure 4.36-10 Side Screw - X-Axis Adjustment



5. Go to Heading 4.4, FLOW CELL CHECKS AND ADJUSTMENTS to ensure the diff adjustment values are within acceptable limits.

4.37 FLOW CELL WBC BALANCE

Purpose

Use this procedure to balance the WBC count generated in the flow cell with the WBC count generated and reported from the WBC/Baso bath. A comparison of these two counts is made to ensure that there are no problems with either system. When they are too far apart, the diff+/diff- flags are generated. These adjustments may be necessary when:

- the optical bench assembly is replaced.
- the flow cell is replaced.
- the flow cell aperture gain is adjusted.
- too many diff+ or diff- flags.
- WBC aperture and calibration have changed.

Tools/Supplies Needed

☐ Fresh blood samples

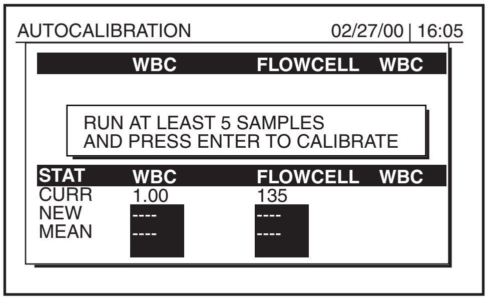
Procedure

1. From the Main Menu, select

   4. Diagnostics ▸▸ 5. Service ▸▸ 8. Flowcell WBC Calibration ▸▸ 1. Autocalibration

   The WBC/Flow Cell Balance screen is displayed (Figure 4.37-1).

Figure 4.37-1 WBC/Flow Cell Balance Screen



AUTOCALIBRATION 02/27/00 | 16:05

RUN AT LEAST 5 SAMPLES
AND PRESS ENTER TO CALIBRATE

STAT	WBC	FLOWCELL WBC
CURR	1.00	135
NEW	----	----
MEAN	----	----

2. Run a fresh normal blood sample at least 5 times. A mean will be established after 3 runs and a new flow cell WBC count calibration factor will be calculated. The raw flow cell WBC count is multiplied by this factor before being matched with the printed WBC count from the WBC bath.
3. Press **ENTER** when the runs are complete. You will then be given the option of accepting (**ENTER)** or rejecting (**ESC)** the new factor. There should be no flagging for the WBC results. If there is, do not accept the new factor. Repeat the procedure, possibly with a different fresh normal blood.

4.38 SETTING diff+/diff- THRESHOLDS

Purpose

Use this procedure to check or set the sensitivity for the diff+ and diff- flags. These flags indicate a difference between the WBC count arrived at in the flow cell and the WBC count derived in the bath.

Tools/Supplies Needed

☐ None

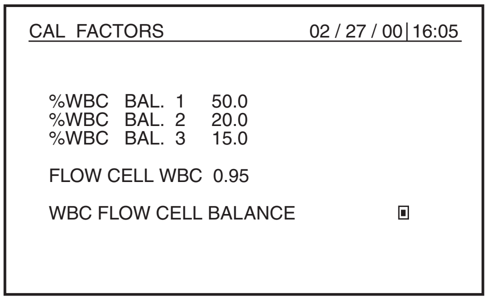
Procedure

1. From the Main Menu, select

   4. Diagnostics ▸▸ 5. Service ▸▸ 8. FlowCell WBC Calibration ▸▸ 2. Cal Factors

   The diff Flag Sensitivity screen is displayed (Figure 4.38-1):

Figure 4.38-1 diff Flag Sensitivity Screen



```
CAL  FACTORS                02 / 27 / 00|16:05

  %WBC  BAL. 1   50.0
  %WBC  BAL. 2   20.0
  %WBC  BAL. 3   15.0

  FLOW CELL WBC  0.95

  WBC FLOW CELL BALANCE               ▣
```

7616104B

2. *WBC FLOWCELL BALANCE LIMIT (%) XX.X* lines set the sensitivity threshold for the diff+/diff- flag, as a percentage. The default values are 50%, 20%, and 15% for BAL 1, BAL 2, and BAL 3 respectively.

   For example, for WBC BAL 2, the diff+/diff- flag will be triggered when enabled, if the (calibration factor corrected)WBC count from the flow cell is more than 20% different from the (calibration factor corrected) WBC BAL 2 count at the WBC/Baso bath.

   The *FLOWCELL WBC XXX* line indicates the flow cell WBC calibration factor that was determined by Heading 4.37, FLOW CELL WBC BALANCE. The flow cell WBC calibration factor can be altered or manually entered on this screen.

   The last line, *WBC FLOWCELL BALANCE* allows the diff+/diff- flagging to be disabled by clearing the enable/disable button.

4.39 MAIN CARD REPLACEMENT AND SOFTWARE TRANSFER

Purpose

Use this procedure to replace the Main Card and transfer the software EPROMs to the new card. The new card is then checked to ensure the settings are correct.

If a software upgrade is also being performed, refer to the appropriate service memo.

Tools/Supplies Needed

- ☐ Allen wrench
- ☐ IC puller, PN 5450537
- ☐ External digital pressure/vacuum gauge (referred to as vacuum meter)
- ☐ Voltmeter

Preliminary Setup

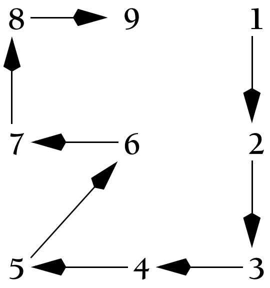
1. Set the instrument to the Manual Startup mode.
   From the Main Menu, select
   4. Diagnostics ▸▸ 5. Service ▸▸ 9. Others ▸▸ 1. User Mode then **Manual Startup**.
2. Print out the system settings before removing the Main card.
   From the Main Menu, select
   5. Setup ▸▸ 6. Others ▸▸ 8. Print System Setup.

   Note: After the new card is installed, the new settings are compared to these settings and adjustments made as necessary.

Removing Main Card

1. Turn off the instrument and unplug the power cord from the wall outlet.
2. Remove the left side panel (Heading 4.2).
3. Starting at the top left corner of the Main card (Figure 4.39-1), remove the cable plugs from the connections shown in Table 4.39-1.
4. Using a 3-mm Allen wrench, remove the nine screws from the Main card in accordance with the sequence shown below.

   ATTENTION: At last position (9), do not allow the screw to drop into shield. Rather, hold the wrench against the screw while removing the card. Turn the card down to allow the screw to drop through the hole in shield.



5. Remove the Main card.

Figure 4.39-1 Main Card - Connections and EPROMs

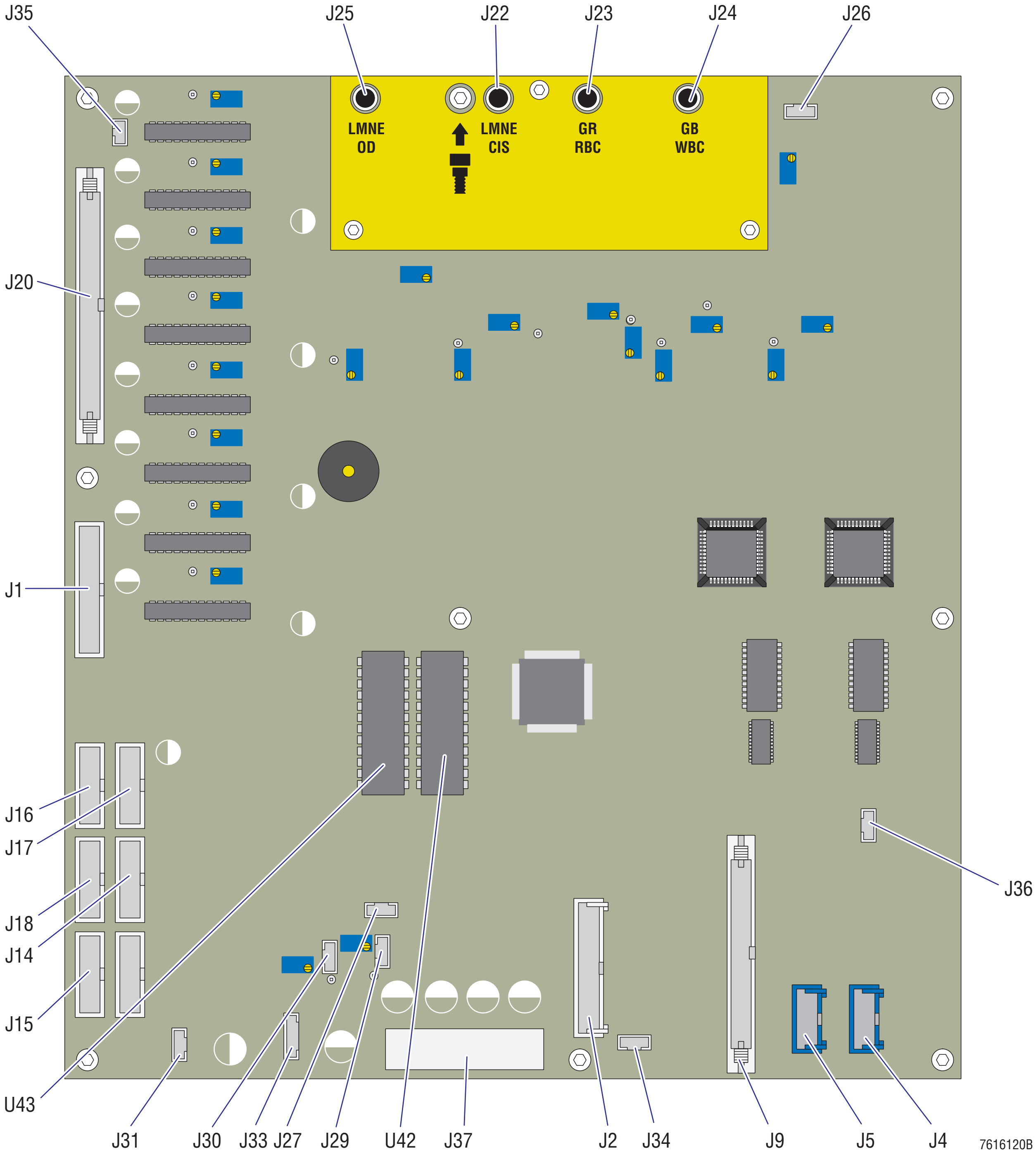

J35
J25
J22
J23
J24
J26
LMNE OD
LMNE CIS
GR RBC
GB WBC
J20
J1
J16
J17
J18
J14
J15
U43
J36
J31
J30
J33
J27
J29
U42
J37
J2
J34
J9
J5
J4
7616120B

Table 4.39-1 Main Card - Plug/Jack Connections

Cable Plug	Color	Number of Wires (type)	Label (on board)
P35	red, blk	2	J35 (3-pin connector)
LMNE OD (P25) LMNE CIS (P22) GR RBC (P23) GB WBC (P24)	blk	(coax)	LMNE OD LMNE CIS GR RBC GB WBC
P26	wht, blu, yel, brn	4	J26
P36	wht	4	J36
P4	gry	(10-wire ribbon)	J4
P5	wht	4	J5 (10-pin connector)
P9	gry	(ribbon)	J9 (40-pin connector)
P34	wht	2	J34 (4-pin connector)
P2	gry	(ribbon)	J2 (26-pin connector)
P37* (pwr supply)	red	12	J37
P27	wht	2	J27 (4-pin connector)
P29	red, grn, blk, wht	4	J29
P30	red, grn, blk, wht	4	J30
P33†	red (3), wht (2), blk	6	J33
P31†	red (2), wht (2)	4	J31
P15, P14 P18, P17, P16	gry	(ribbon)	J15, J14 J18, J17, J16 (14-pin connectors)
P1	blk	ribbon	J1 (26-pin connector)
P20	gry	ribbon	J20 (52-pin connector)

* P37 plug holes are offset to the top. DO NOT use excessive force when installing plug.
† Plug label shows thermistor values in ohms.

Transferring EPROMs to Replacement Card

Note: Software EPROMs are not provided with the replacement card.

CAUTION DO NOT pry up EPROMs with screwdriver. Prying up the EPROMs can damage the lands on the card. Remove the EPROMs with an IC puller.

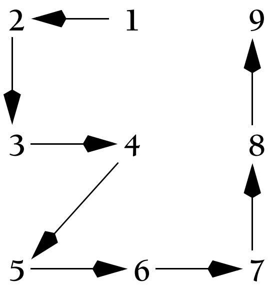
---

1. Using the IC puller, remove the EPROMs U42 (right) and U43 (left) from the old Main card. See Figure 4.39-1 for location. Set the puller over the EPROM and pull straight out.
2. Check the EPROM labels for proper identification, software version and addresses (U42 is labeled "odd" and U43 labeled "even").
3. Insert U42 (right) and U43 (left) into their plug-ins on the card, NOTCH UP.

Installing Main Card

1. Using a 3-mm Allen wrench, install the nine screws to secure the Main card to the instrument in accordance with the sequence shown below.

   ATTENTION: At position 1, start threading the screw through the shield into the card first, then hold the wrench against the screw and mount the card on the instrument. Complete threading the screw but leave it loose for aligning other screws.



Note: Secure the ground strap at position 2.

2. Install all connections listed in Table 4.39-1.

CAUTION If, following the Beckman Coulter logo the instrument begins a **rinse cycle**, immediately TURN OFF the instrument. Damage can occur to the probe if the instrument was not set for Manual Startup mode.

---

3. Connect power cord to ac wall outlet and turn on the instrument. The *Beckman Coulter* logo, along with the revision level of the software (x.xx) is displayed on the screen in approximately 7 seconds. Continue to check the instrument settings as outlined in "Verifying System Configuration" and "Verifying Main Card Settings" below.
   a. If only a single line appears on the screen, turn off the instrument and check the positions of the EPROMs (U43 and U42); they may be reversed.
   b. If the instrument begins a **rinse cycle:**
      1) Turn off the instrument.
      2) Open the right side door and turn on the instrument. One or both of the folowing messages is displayed:

         SYSTEM ERROR RUN SYSTEM RESET CYCLE

         BATH ENCLOSURE DOOR OPEN

      3) Press ESC to access the Main Menu and select **4. Diagnostics** ▸▸ **5. Service** ▸▸ **9. Others** ▸▸ **1. User Mode** then **Manual Startup**.
4. Power Off, close the right side door and power On again. The instrument should not attempt to do a rinse cycle.

Verifying System Configuration

Use this procedure when replacing a Main card and the configuration of the replacement card is unknown.

1. Reset values to default. From the Main Menu, select

   4. Diagnostics ▸▸ 5. Service ▸▸ 9. Others ▸▸ 4. Setting to Default Values.

   The instrument prints the current values and then resets to the defaults. Enter the settings as listed in Table 4.39-2 and compare them to the original system setup (printed in step 2 of "Preliminary Setup").

   :

Table 4.39-2 A^{C}•T 5diff Menu Paths - System Settings

Parameter	**From Main Menu...**
Date Format	**5. Setup ▸▸ 1. Date/Time ▸▸ 2. Date Format**
Time Format	**5. Setup ▸▸ 1. Date/Time ▸▸ 1.Time Format**
Units	**5. Setup ▸▸ 2. Units**
Language	**5. Setup ▸▸ 6. Others ▸▸ 5.Language.** If American English, set "USA" to selected or (enable).
Manual Startup	**4. Diagnostics ▸▸ 5. Service ▸▸ 9. Others ▸▸ 1. User Mode** then **Manual Startup**
Service	**4. Diagnostics ▸▸ 5. Service ▸▸ 9. Others ▸▸ 1. User Mode**
Identification Mode	**5. Setup ▸▸ 6. Others ▸▸ 2. Identification Mode**
Bar Code with Checksum	**5. Setup ▸▸ 6. Others ▸▸ 2. Identification Mode**
Display DIFF #	**5. Setup ▸▸ 6. Others ▸▸ 2. Identification Mode**
Enable ATL, IMM, PCT, PDW	**5. Setup ▸▸ 6. Others ▸▸ 2. Identification Mode**
Sequence Number	**5. Setup ▸▸ 6. Others ▸▸ 2. Identification Mode.** Resets to "1".
Identification Number	**5. Setup ▸▸ 6. Others ▸▸ 2. Identification Mode.** Resets to "1".
Reset Time	**5. Setup ▸▸ 6. Others ▸▸ 2. Identification Mode**
Operators	**5. Setup ▸▸ 6. Others ▸▸ 1. Calibration ▸▸ 2. Define Operators**
Calibration Factors	**2. Calibration ▸▸ 2. Cal Factors**
CV% Limits	**5. Setup ▸▸ 6. Others ▸▸ 1. Calibration ▸▸ 1. CV% Limits**
Flow Cell WBC Calibration	**4. Diagnostics ▸▸ 5. Service ▸▸ 8. Flowcell WBC Calibrationn ▸▸ 2. Cal Factors** %WBC BA1 50.0 %WBC BA2 20.0 %WBC BA3 15.0 FLOW CELL WBC X.XX WBC FLOW CELL BALANCE (enable)
Daily Workload	**3. Reagents ▸▸ 2. Daily Workload**

Table 4.39-2 A^{C}•T 5diff Menu Paths - System Settings *(Continued)*

Parameter	From Main Menu…
Cycle Counts	**5. Setup ▸▸ 6. Others ▸▸ 7. Cycle Counts** Resets to "0".
Autoclean Frequency	**5. Setup ▸▸ 6. Others ▸▸ 3. Autoclean Frequency**
Burn In	**4. Diagnostics ▸▸ 5. Service ▸▸ 7. Burn-In ▸▸ 1. Burn-In Cycles**
Heating Coil Thermistor Value	**4. Diagnostics ▸▸ 5. Service ▸▸ 3. Heating Systems ▸▸ 1. Heating Coil ▸▸ 1. Adjustment.** Press ENTER for calculation after updating the value.
Heating Coil Reference Temperature	**4. Diagnostics ▸▸ 5. Service ▸▸ 3. Heating Systems ▸▸ 1. Heating Coil ▸▸ 2. Reference.** Adjust reference temperature setting.
Bath Enclosure Thermistor Value	**4. Diagnostics ▸▸ 5. Service ▸▸ 3. Heating Systems ▸▸ 2. Bath Enclosure ▸▸ 1. Adjustment** Press ENTER for calculation after updating the value.
Bath Enclosure Reference Temperature	**4. Diagnostics ▸▸ 5. Service ▸▸ 3. Heating Systems ▸▸ 2. Bath Enclosure ▸▸ 2. Reference** Adjust reference temperature setting.
Dilution	**4. Diagnostics ▸▸ 5. Service ▸▸ 1. Dilution**
Mixing	**4. Diagnostics ▸▸ 5. Service ▸▸ 4. Mixing**
Vacuum	**4. Diagnostics ▸▸ 5. Service ▸▸ 6. Vacuum Check ▸▸ 1. Counting**
Pulse Adjustment	**4. Diagnostics ▸▸ 5. Service ▸▸ 2. Measurement ▸▸ 6. Pulse Adjustment**
Reagent Volumes	**5. Setup ▸▸ 6. Others ▸▸ 6. Reagent Volumes**
Reagent Lot Numbers	**3. Reagents ▸▸ 1. Level Change** then select **Change All.** Enter the lot numbers from the old system settings. After the last number is entered, the instrument primes all the reagents. **Note:** If new or full reagent containers are not placed in the system, the cycle count will not represent the actual volume of reagent in the bottles.
Printer Configuration	**5. Setup ▸▸ 5. Printer ▸▸ 1. Printer Configuration.** In addition, Rev 1.03 or later has Histograms Thresholds as an option.
Institutional Header	**5. Setup ▸▸ 5. Printer ▸▸ 2. Institutional Header**
Sending Options	**5. Setup ▸▸ 4. Host Setup ▸▸ 3. Sending Options**
Host Setup Configuration	**5. Setup ▸▸ 4. Host Setup ▸▸ 1. Host Setup Configuration**
Format	**5. Setup ▸▸ 4. Host Setup ▸▸ 2. Sending Configuration**
Variable Format Setup	**5. Setup ▸▸ 4. Host Setup ▸▸ 4. Variable Format Setup**

Patient Ranges, Action Ranges and Thresholds

If the instrument was using the default values for *Patient Ranges*, *Action Ranges* and *Thresholds* (on all 9 ranges), then the software retains these values. If the values were not set to default, then re-enter the values from the old system setup.

Note: Rev 1.03 Software defaults to "Simple Flagging" and no "Threshold Flags." To set the DIFF Plot and Histogram Flags to On, from the Main Menu, select

5. Setup ▸▸ 5. Printer ▸▸ 1. Printer Configuration then enable **DIFF Plot and Histogram Flags**.

Verifying Main Card Settings

Use this procedure to verify the Main card settings after the replacement of the card.

1. Compare the settings listed in Table 4.39-3 to the readings taken from the Main card and adjust as required. Use Figure 4.39-2 to locate the potentiometer and corresponding test point.

:

Table 4.39-3 AcT 5diff - Main Card Settings

Function (Heading)	Adjustment		Target	Range	Test Point
Motor Current Adjustment (4.13)	Draining Syringe	R149	4.0 V	±0.05 V	TP5
	Counting Syringe	R150	4.0 V	±0.05 V	TP6
	Diluter Syringe	R151	4.0 V	±0.05 V	TP7
	Injector Syringe	R152	3.0 V	±0.05 V	TP8
	Horizontial Carriage	R154	3.0 V	±0.05 V	TP10
	Sample Syringe	R155	2.0 V	±0.05 V	TP11
	Probe Carriage	R156	4.5 V	±0.05 V	TP12
Threshold Adjustments (4.14)	BASO	R157	300 mV	±5 mV	TP14
	RBC	R158	300 mV	±5 mV	TP13
	PLT	R159	300 mV	±5 mV	TP2
	FLOW CIS	R160	650 mV	±5 mV	TP3
	FLOW OD	R161	350 mV	±5 mV	TP4
Drain Sensor Adjustment (4.11)	Drain Sensor	R287	4.5 V (empty) <1.0 V (full)	±0.3 V	TP52 (under P30)
DIFF Bath Drain Sensor Adjustment (4.12)	Diff Bath Drain Sensor	R286	4.5 V (empty) <1.0 V (full)	±0.3 V	TP48 (under P29)
Vacuum Checks and Adjustments (4.17)	Counting Syringe	Step value	6.5 inches Hg	stable	test box attached to bottom port on side of syringe
Vacuum Checks and Adjustments (4.17)	Draining Syringe	Non-adjustable	7.7 inches Hg	stable	test box attached to top port on side of syringe
HGB Blank Adjustment (4.7)		R248	4.7 V	±0.3 V	screen
Aperture Current Check (4.8)		Non-adjustable	60 V		J22, J23, J24
RBC/PLT Gain Adjustment (4.9)	RBC Gain	R133	Channel 78		screen
	PLT Gain	R135	Channel 112		screen
WBC/BASO Gain Adjustment (4.10)		R134	Channel 102		screen

Table 4.39-3 AcT 5diff - Main Card Settings

Function (Heading)	Adjustment		Target	Range	Test Point
DIFF Lamp Voltage Adjustment (4.4)		R11	6.0v	5.50 - 6.50 V	screen
Transfer Time (4.4)		shim	200	150 - 250	screen
Resistive Channel Adjustment (4.4)		R136	50	45 - 55	screen
	Final Gain Using Fresh Whole Blood	R136	good scatterplot distribution		scatterplot
Absorbance Channel Adjustment (4.4)		R148	>170	adjust to max 170 - 190	screen
	Final Gain Using Fresh Whole Blood	R148	good scatterplot distribution		scatterplot

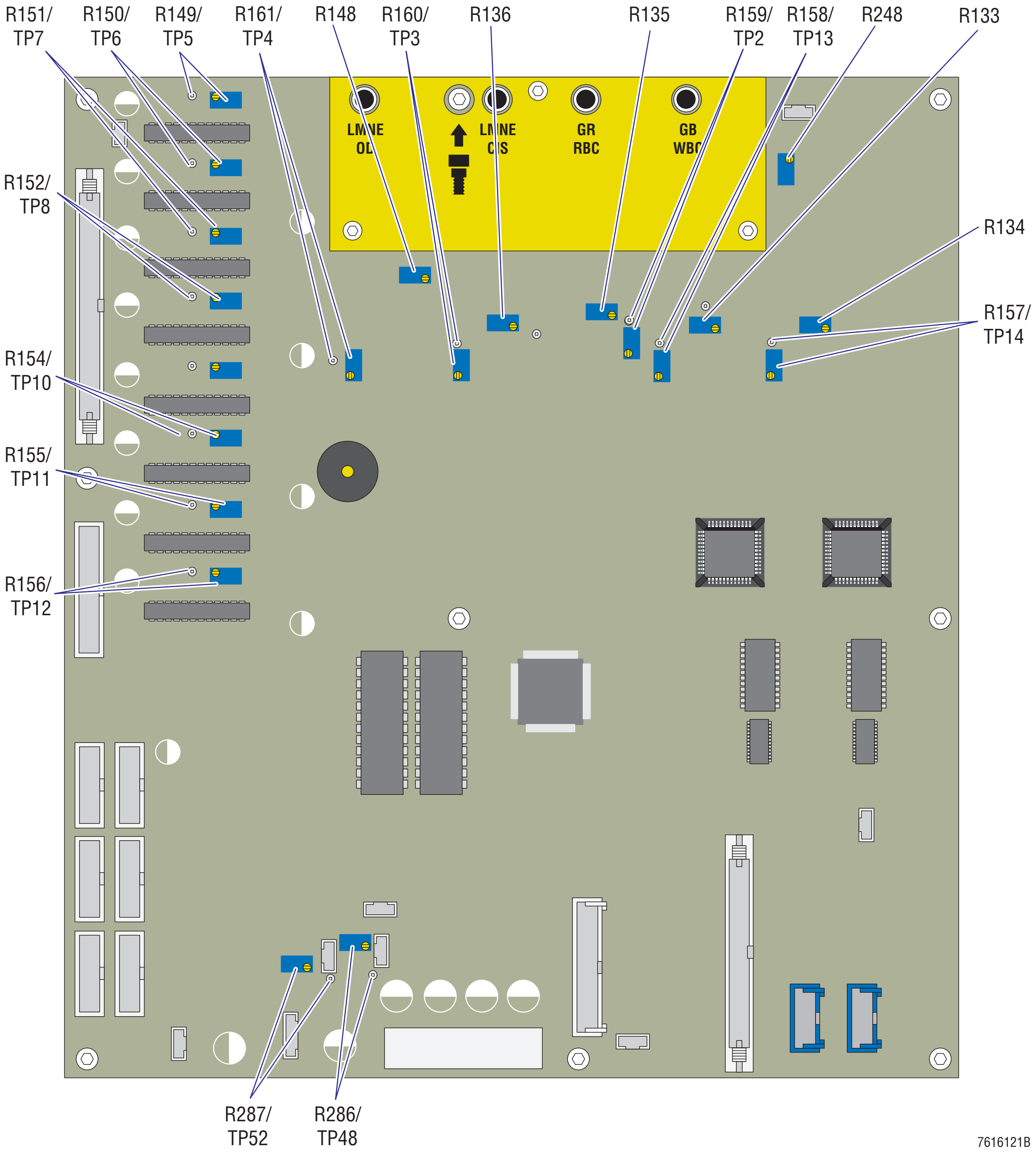
2. Use a fresh normal whole-blood specimen to check instrument reproducibility.
   a. From the Main Menu, select **2. CALIBRATION ▸▸ 4. REPRODUCIBILITY**.
   b. Run eleven samples and then delete the first one for a ten-shot reproducibility.
   c. Verify the reproducibility results are within acceptable limits. See Table 4.39-4.

Table 4.39-4 Whole-Blood Reproducibility CV Limits for 20 Cycles

Parameter	%CV	Test Level
WBC	<2.0%	at 10.0 x 10^3/µL
RBC	<2.0%	at 5.00 x 10^6/µL
Hgb	<1.0%	at 15.0 g/dL
Hct	<2.0%	at 45.0%
MCV	<1.0%	at 90.0 fL
Plt	<5.0%	at 300 x 10^3/µL

3. Run controls and confirm results fall within expected ranges.

Figure 4.39-2 Main Card - Potentiometers /Test Points


R151/ TP7
R150/ TP6
R149/ TP5
R161/ TP4
R148
R160/ TP3
R136
R135
R159/ TP2
R158/ TP13
R248
R133
R152/ TP8
R134
R157/ TP14
R154/ TP10
R155/ TP11
R156/ TP12
LMNE OL
LMNE CIS
GR RBC
GB WBC
R287/ TP52
R286/ TP48
7616121B

5 MAINTENANCE PROCEDURES, 5.1-1

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TABLES

5.1-1 Maintenance Schedule, 5.1-1

5.1 RECOMMENDED MAINTENANCE SCHEDULE

Table 5.1-1 lists the maintenance procedures for the A^C•T 5diff hematology analyzer and when they should be performed. Maintenance is based on the number of cycles; therefore, the frequency a maintenance procedure needs to be done is driven by the customer workload. The maintenance schedule in Table 5.1-1 is the customer workload translated into a time schedule.

Table 5.1-1 Maintenance Schedule

Workload (Cycles Per Day)	**<30**		**30 to 120**				**>120**		**PMI Kit**
Maintenance Frequency	**1Y**	**2Y**	**6M**	**1Y**	**18M**	**2Y**	**6M**	**1Y**	
Replace rinse block O-ring and washer	X	X	X	X	X	X	X	X	6 months Maintenance Kit, PN - XEA485AS
Replace reagent syringe O-rings and washers	X	X	X	X	X	X	X	X	
Replace waste syringe O-ring and washer	X	X	X	X	X	X	X	X	
Replace count syringe O-ring and washer	X	X	X	X	X	X	X	X	
Clean the bath enclosure	X	X	X	X	X	X	X	X	
Replace sample syringe O-rings	X	X		X		X	X	X	1 year Maintenance Kit, PN - XEA486AS
Replace 5diff syringe O-rings	X	X		X		X	X	X	
Replace draining chamber O-rings	X	X		X		X	X	X	
Replace optical bench lamp	X	X		X		X	X	X	
Replace flow cell coaxial cable	X	X		X		X	X	X	
Replace diluent reservoir O-ring and washer	X	X		X		X	X	X	
Replace counting head coax and aperture O-rings	X	X		X		X	X	X	
Replace sample probe and rinse block		X				X		X	Every 2 years Maintenance Kit, PN - XEA581AS
Replace reagent syringe pistons		X				X		X	
Replace waste syringe piston		X				X		X	
Replace count syringe piston		X				X		X	

5.2 MAINTENANCE WORKLIST

Purpose

Use this procedure as a guide when the 6-months, 1-year, or every 2-years maintenance is needed. 6-months maintenance mainly consists of replacing O-rings and washers. The 1-year maintenance is more extensive and includes all the procedures that would typically be done during the 6-months maintenance. The every 2-years maintenance is the most extensive because it also includes all the 6-months and 1-year maintenance procedures.

A worklist is provided to guide you through the various procedures and checks that need to be done to complete a scheduled maintenance. Make a copy of this worklist before starting the maintenance procedures and use it as a checklist to help you keep track of your progress. You may also use this worklist as a record if you sign and date it.

Tools/Supplies Needed

☐ 6 months maintenance kit, PN - XEA485AS
☐ Allen wrench, 2.5 mm and 3.0 mm
☐ Torque screwdriver, 2.5 mm hex-ball and T10 torx
Note: 100 mN.m (14.2 ozf.in) and 400 mN.m (56.8 ozf.in) torques are required.
☐ Cutting pliers
☐ High quality, fragrance-free bleach (10-12% sodium hypochlorite - available chloride)
☐ Distilled water
☐ Absorbent paper towels
☐ Lint-free tissues

Additional Tools or Supplies Needed for 1-Year Maintenance

☐ 1 year maintenance kit, PN - XEA486AS
☐ Small Phillips-head screwdriver
☐ Allen wrench, 2 mm
☐ Hemostat or tweezers with a pointed end
☐ Small side cutters
☐ White paper towel or cloth
☐ Cotton-tip applicator swab

Additional Tools or Supplies Needed for the Every 2-Years Maintenance

☐ Every 2 years maintenance kit, PN - XEA581AS

User Mode

While performing these maintenance procedures, you are instructed to set the User mode to Service. In this mode, the right side door interlock is bypassed. When the instrument is operating with the right side door open, it is important to avoid any unnecessary contact with the sample probe. The probe is sharp and may contain biohazard materials. When the service call is complete, make sure the interlock is reactivated to ensure the Customer is not accidently injured by the sample probe or its movement.

Worklist Instructions

Overview

The maintenance worklist is a composite guide for the 6-months, 1-year, and every 2-years maintenance procedures. After providing you with the steps required to prepare the instrument for maintenance, the worklist directs you to the individual service and repair procedures needed to complete maintenance in the left compartment. When these replacements are complete, an interim verification check is done to ensure there is no leakage before moving to the right compartment. After performing replacements inside the right compartment, another verification is done to again ensure there is no leakage. When all the required maintenance procedures are completed, an overall system verification is done to ensure proper operation.

Maintenance Category Identifier

Since this worklist is a composite of the three possible maintenance schedules, a block containing the maintenance category appears before each procedure:

[6 months / 1 year / 2 years] indicates a procedure that must be completed each time maintenance is done on an A^{C}•T 5diff hematology analyzer.

[1 year / 2 years] indicates a procedure that is completed only when the 1 year or every 2 years maintenance is done. When doing a 6 months maintenance, this procedure is not required.

[6 months] appears only once to direct you to perform the System Verification Procedures when you are doing a 6 months maintenance.

If you are doing a 6 months maintenance, follow the instructions in the rows marked **[6 months / 1 year / 2 years]** or **[6 months]**. If you are doing a 1 year or every 2 years maintenance, follow the instructions in the rows marked **[6 months / 1 year / 2 years]** or **[1 year / 2 years]**.

Basic Instructions

Preparation instructions for performing the required maintenance are provided at the beginning of the worklist. These instructions supersede the preparation instructions in the individual service and repair procedures. As a result, when you are directed to a particular service and repair procedure, you are usually directed to begin at the **Removal** heading and further directed as to what subsequent headings need to be completed. In most cases, you will not complete the Verification in the individual procedures. When all the required maintenance procedures are completed, you will be directed to do an overall system verification to ensure the instrument is operating properly before you close out the service call. It is important for you understand that by carefully reading and following the directions associated with each procedure you will avoid doing unnecessary work.

Before starting a maintenance call, make a copy of the complete worklist that begins on the next page. Since this worklist consolidates all the individual procedures, it is important to progress through the procedures in their designated order. Use this worklist as a guide to ensure all needed maintenance procedures are completed. As you finish each task, place a checkmark (✓) next to the completion statement to keep track of your progress as you work through the various procedures.

MAINTENANCE WORKLIST

Copy this worklist and use it as a guide to ensure all needed maintenance procedures are completed. In the electronic version of this manual, a file (worklist.pdf) is provided for printing. As you finish each task, place a checkmark (✓) next to the completion statement to keep track of your progress as you work through the various procedures.

Replacements in the Left Side Compartment

[6 months / 1 year / 2 years]

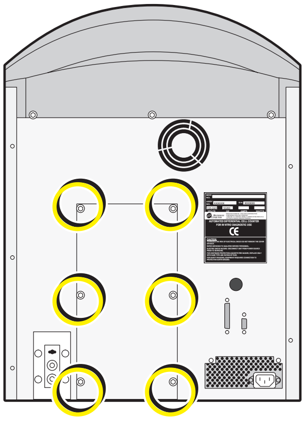
Preparation

1. Use the maintenance kit part listings to ensure no parts are missing from the kit.
    - If performing a 6-months maintenance, use Table 8.1-10.
    - If performing the 1-year maintenance, use Table 8.1-10 and 8.1-11.
    - If performing every 2-years maintenance, use Table 8.1-10, 8.1-11, and 8.1-12.
2. If off, turn the instrument on.
3. From the Service menu, select **9. OTHERS ▸▸ 1. USER MODE.**
4. At the instrument keypad,
    a. Press the down arrow key to move the blinking cursor to the *SERVICE* box.
    b. Press the decimal point key. Make sure a dot appears inside the box.

    Note: If you press the decimal point too long, the dot may disappear. The dot indicates the right side door interlock is bypassed.

    c. Press **ESC** to return to the Others menu.
5. From the Others menu, select **3. PARK SYRINGES**. When the park syringes prompt appears, press **ENTER**.
6. When the park syringes routine is complete, turn the instrument off.
7. At the rear of the instrument,
    a. Disconnect the power cord.
    b. Remove the six hex screws securing the rear access panel.

    Note: Use a 3 mm hex key to remove any hex screws securing an instrument cover. For details, see Heading 4.2.



    c. Remove the rear access panel and set it aside.

8. Remove the four hex screws securing the left side panel to the instrument frame and set the door aside.

CAUTION A flat cable is connected to the rear of the Main card. Be careful when you open the door (where the Main card is attached) that you do not disconnect or damage this cable.

---

9. In the left side compartment,
    a. Turn the two captive knobs counterclockwise to release the Main card door. These knobs are located to the right of the Main card.
    b. Open the Main card door and carefully anchor the door behind the white plastic catch to keep it open.

[1 year / 2 years]

10. Remove the top cover:
    a. In the left side compartment, remove the hex screw in the front upper corner.
    b. Open the right side door and remove the hex screw in the front upper corner.
    c. At the rear of the instrument, remove the three hex screws securing the top cover to the instrument frame.
    d. Carefully remove the top cover and set it aside.

__________ **Preparation complete.**

[6 months / 1 year / 2 years]

Reagent Syringes Assembly

Replacement Parts

From the 6 months maintenance kit:

- ☐ Washer and silicone O-ring, PN - XDA622A (4 sets)
- ☐ Silicone O-ring for the Hgb Lyse reagent syringe piston, PN - FAA065A
- ☐ Silicone grease, PN - XEA019A

From the every 2 years maintenance kit:

- ☐ Reagent syringe piston, PN - GBC030A (need 4)
- ☐ Hgb Lyse reagent syringe piston, PN - GBC031A

Procedure

Under Heading 4.24, REAGENT SYRINGES ASSEMBLY REPLACEMENTS, complete the following sections:

_______ Removal

_______ O-Ring, Washer, and Piston Replacement

- If performing the 6 months or 1 year maintenance, replace the O-rings and washers only. Do not replace the pistons.
- If performing the every 2 years maintenance, replace all pistons, O-rings, and washers.

_______ Installation

__________ **All reagent syringes assembly replacements are complete.**

[1 year / 2 years]

5diff Syringe Assembly

Replacement Parts

From the 6 month maintenance kit:

☐ Silicone grease, PN - XEA019A

From the 1 year maintenance kit:

☐ Silicone O-ring, PN - FAA040A
☐ Fluorocarbon O-rings, PN - FAA067A (need 4)

Procedure

Under Heading 4.29, 5diff SYRINGE ASSEMBLY REPLACEMENTS, complete the following sections:

_______ Removal

_______ O-ring Replacements
Note: Replace five O-rings, one silicone and four fluorocarbon.

_______ Installation

_________ **All five O-rings are replaced.**

[6 months / 1 year / 2 years]

Count Syringe Assembly

Replacement Parts

From the 6 months maintenance kit:

☐ Washer and O-ring, PN - XDA621A
☐ Silicone grease, PN - XEA019A

From the every 2 years maintenance kit:

☐ Count syringe piston, PN - GBG052A

Procedure

Under Heading 4.25, COUNT SYRINGE COMPONENT REPLACEMENTS, complete the following sections:

_______ Removal

_______ O-ring, Washer, and Piston Replacement

- If performing the 6 months or 1 year maintenance, replace the O-rings and washers only. Do not replace the pistons.
- If performing the every 2 years maintenance, replace all pistons, O-rings, and washers.

_______ Installation

_________ **All count syringe replacements are complete.**

[6 months / 1 year / 2 years]

Interim Verification Check

1. Reconnect the power cord.
2. Turn the instrument on.
3. Press the **STARTUP** button on the instrument keypad.
4. When the Startup routine and background check are done,
   - If performing the 6 months maintenance, verify the reagents syringe assembly and the count syringe assembly are not leaking.
   - If performing the 1 year or every two years maintenance, verify the reagents syringe assembly, the 5diff syringe assembly, and the count syringe assembly are not leaking.
5. Open the right side door and check the right compartment for leaks. A tubing connected on the wrong port inside the left compartment may cause leaking inside the right compartment.
6. If no leakage is seen, prime the reagents.

   From the Main Menu, select **3. REAGENTS ▸▸ 3. PRIME ▸▸ 6. ALL REAGENTS**.
7. When the prime cycles are done,
   a. Check the reagents syringe assembly, the 5diff syringe assembly (if applicable), and the count syringe assembly for leaks.
   b. Check the right side compartment for leaks.
8. If no leaks are detected,
   a. Turn the instrument off.
   b. Disconnect the power cord.
   c. Do the electronic replacements that follow.

__________ **Syringe assemblies inside the left compartment are not leaking.**

[1 year / 2 years]

Replace the Optical Bench Lamp

Replacement Part

From the 1 year maintenance kit:

☐ Optical bench lamp, PN - DAJ007A

Procedure

Under Heading 4.31, OPTICAL BENCH LAMP REPLACEMENT, complete the following sections:

________ Removal

________ Lamp Replacement

__________ **Optical bench lamp is replaced.**

[1 year / 2 years]

Replace the Flow Cell Coaxial Cable

Replacement Part

From the 1 year maintenance kit:

☐ DIFF flow cell coaxial cable, PN - XBA399A

Procedure

Under Heading 4.30, FLOW CELL COAXIAL CABLE REPLACEMENT, complete the following sections:

_______ Removal

_______ Replacement

_______ Under Heading 4.4, do the Flow Cell Checks.
Note: If a value is outside acceptable limits, do the appropriate adjustment.

_________ **Flow cell coaxial cable is replaced and the flow cell checks are within acceptable limits.**

Replacements in the Right Side Compartment

[6 months / 1 year / 2 years]

Preparation

1. From the Service menu, select **9. OTHERS** ▸▸ **3. PARK SYRINGES**. When the park syringes prompt appears, press **ENTER**.
2. When the park syringes routine is complete, turn the instrument off.
3. Disconnect the power cord.
4. Open the pneumatic access door (right side of the instrument).
5. Manually push down on the waste syringe piston until it reaches its lowest position.

_________ **Preparation complete.**

[6 months / 1 year / 2 years]

Sample Probe and Rinse Block Assembly

Replacement Parts

From the 6 month maintenance kit:

- ☐ O-ring, fluorocarbon, PN - FAA053A
- ☐ Silicone grease, PN - XEA019A

From the 2 year maintenance kit:

- ☐ Sample probe, PN - XDA619AS
- ☐ Sample probe guide, PN - GBG091A

Procedure

In the right side compartment, manually push the sample probe housing towards the rear of the instrument then under Heading 4.26, SAMPLE PROBE AND RINSE BLOCK ASSEMBLY COMPONENT REPLACEMENTS, complete the following sections:

_______ Removal

_______ Rinse Block Assembly Component Replacement

- If performing the 6 months or 1 year maintenance, replace the O-ring only.
- If performing the every 2 years maintenance, replace the sample probe, the probe guide, and its O-ring.

_______ Installation

_________ **All needed components are replaced.**

[1 year / 2 years]

Sample Syringe Assembly

Replacement Part

From the 1 year maintenance kit:

- ☐ Fluorocarbon O-ring, PN - FAA064A (need 2)

Procedure

Under Heading 4.33, SAMPLE SYRINGE ASSEMBLY REPLACEMENTS, complete the following sections:

_______ Removal

_______ O-ring Replacements

_______ Installation

_________ **O-rings replaced.**

[6 months / 1 year / 2 years]

Waste Syringe Assembly

Replacement Parts

From the 6 months maintenance kit:

☐ Washer and O-ring, PN - XDA621A
☐ Silicone grease, PN - XEA019A

From the every 2 years maintenance kit:

☐ Waste syringe piston, PN - GBG052A

Procedure

Under Heading 4.27, WASTE SYRINGE COMPONENT REPLACEMENTS, complete the following sections:

_______ Removal

_______ O-ring, Washer, and Piston Replacement

- If performing the 6 months or 1 year maintenance, replace the O-ring and washer only. Do not replace the piston.
- If performing the every 2 years maintenance, replace the syringe piston, O-ring, and washer.

_______ Installation

_________ **All waste syringe replacements are complete.**

[1 year / 2 years]

Diluent Reservoir

Replacement Parts

From the 1 year maintenance kit:

☐ O-ring and washer, PN - XEA286AS

Procedure

Under Heading 4.32, DILUENT RESERVOIR REPLACEMENTS, complete the following sections:

_______ Removal

_______ O-ring and Washer Replacement

_______ Installation

_________ **O-ring and washer replaced.**

[6 months / 1 year / 2 years]

Interim Verification Check

1. Reconnect the power cord.
2. Turn the instrument on.

WARNING Risk of personal injury. The right side door interlock is bypassed which allows you to observe instrument operation with the right side door open. Avoid any unnecessary contact with the sample probe. The probe is sharp and may contain biohazardous materials.

3. Press the **STARTUP** button on the instrument keypad.
4. When the Startup routine and background check are done,
   - If performing the 6 months maintenance, verify the waste syringe is not leaking.
   - If performing the 1 year or every two years maintenance, verify the waste syringe, the diluent reservoir, and the sample syringe are not leaking.
5. Check the left side compartment for leaks. A tubing connected on the wrong port inside the right compartment may cause leaking inside the left side compartment.
6. From the Main Menu, select **4. DIAGNOSTICS** ▸▸ **4. HARDWARE SYSTEMS** ▸▸ **4. TRAVERSE SERVICE POSITION**.
   a. When the traverse service position prompt appears, press **ENTER**.
   b. Verify the sample probe rinse block is not leaking.
   c. Press **ESC** twice to return to the Diagnostics menu.

_________ **Assemblies inside the right and left compartments are not leaking.**

[1 year / 2 years]

Preparation

1. From the Diagnostics menu, select **3. DILUTER SYSTEMS** ▸▸ **3. DRAIN BATHS** ▸▸ **6. ALL BATHS**.
2. Verify all baths (including the draining baths and rinse chamber) are empty.
3. Turn the instrument off.
4. Disconnect the power cord.
5. Do the draining bath and counting head replacements that follow.

_________ **Preparation complete.**

[1 year / 2 years]

Draining Baths

Replacement Parts

From the 1 year maintenance kit:

☐ O-ring, PN - FAA066A (one for each bath)

Procedure

Under Heading 4.34, DRAINING BATH REPLACEMENTS, complete:

_______ O-ring Replacements

_________ **O-rings are replaced.**

[1 year / 2 years]

Counting Heads

Replacement Parts

From the 1 year maintenance kit:

☐ Coaxial cable O-ring, PN - FAA046A (need 1 for each bath)

☐ Aperture O-ring, PN - GBG156A (need 2 for each bath)

Procedure

Under Heading 4.35, O-RING REPLACEMENTS IN THE COUNTING BATHS (RBC and WBC/BASO Baths), complete the following sections:

_______ Removal

_______ O-ring Replacements

_______ Installation

_______ Align the Bath Assembly

_______ Verification which also includes the SYSTEM VERIFICATION PROCEDURES.

_________ **Coaxial cable and aperture O-rings are replaced. None of the baths are leaking.**

_________ **All system verification checks are acceptable.**

[6 months / 1 year / 2 years]

Clean the Bath Enclosure

Under Heading 4.28, CLEANING THE BATH ENCLOSURE, complete the procedure as written.

_________ **Bath enclosure cleaned as directed.**

[6 months / 1 year / 2 years]

Wrap Up

[6 months]

WARNING Risk of personal injury. The right side door interlock is bypassed which allows you to observe instrument operation with the right side door open. Avoid any unnecessary contact with the sample probe. The probe is sharp and may contain biohazardous materials.

Perform a system verification as instructed under Heading 5.3, SYSTEM VERIFICATION PROCEDURES.

_________ **All system verification checks are acceptable.**

[1 year / 2 years]

1. Replace the top cover:
    a. Carefully position the top cover on the instrument.
    b. In the left side compartment, replace the hex screw in the front upper corner.
    c. Open the right side door and replace the hex screw in the front upper corner.
    d. At the rear of the instrument, replace the three hex screws that secure the top cover to the instrument frame.

[6 months / 1 year / 2 years]

2. Replace the rear access panel using the six hex screws removed earlier.
3. In the left side compartment,
    a. Lift the white plastic catch to release the Main card.
    b. Close the Main card door and turn the two captive knobs clockwise to secure it.
4. Replace the left side panel and install the four hex screws removed earlier.
5. Close the right side door.

WARNING Risk of personal injury. The right side door interlock is bypassed allowing operation with the right side door open. The probe is sharp and may contain biohazardous materials. When all the maintenance procedures are complete, make sure the interlock is reactivated to ensure the Customer is not accidently injured by the sample probe or its movement.

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6. From the Service menu, select **9. OTHERS ▸▸ 1. USER MODE.**
7. At the instrument keypad,
    a. Press the down arrow key to move the blinking cursor to the *SERVICE* box.
    b. Press the decimal point or **DEL** key. Make sure the dot no longer appears inside the *SERVICE* box. The right side door interlock is reactivated.

       Note: If you press the decimal point too long, the dot may reappear. The dot indicates the right side door interlock is bypassed.
    c. Press **ESC** as many times as necessary to return to the Main Menu.

_________ **All panels and covers are replaced. The right side door interlock is reactivated.**

________ **6 months maintenance procedures are completed.**

________ **1 year maintenance procedures are completed.**

________ **Every two years maintenance procedures are completed.**

Date of Completion ________________________________

Institution ________________________________

Completed by ________________________________

5.3 SYSTEM VERIFICATION PROCEDURES

Purpose

Use this procedure at the end of each service call to verify the A^{C}•T 5diff hematology analyzer is operating correctly.

Tools/Supplies Needed

☐ Fresh, normal whole- blood specimens
☐ Calibration blood specimens

Preparation

WARNING Risk of personal injury or contamination. If you do not properly shield yourself while servicing the instrument, you may become injured or contaminated. To prevent possible injury or biological contamination, you must wear appropriate safety glasses, a lab coat, and gloves when servicing the instrument.

IMPORTANT Risk of misleading results. This procedure must be performed on a clean instrument. If it is suspected that the instrument is not perfectly clean, perform the PREPARATION TO SHIP THE INSTRUMENT procedure under Heading 4.3.

Startup

Run a Startup cycle and background check.

Reproducibility

Use one fresh, normal whole-blood specimen to check instrument reproducibility.

1. From the Main Menu, select **2. CALIBRATION ▸▸ 4. REPRODUCIBILITY**.
2. Do a 20 sample reproducibility study in the CBC mode of operation. Verify the results from these runs are not flagged.
3. Verify the reproducibility results are within acceptable limits. See Table A.1-6.
4. Run a fresh, normal whole-blood specimen in the CBC/DIFF to verify normal specimens are not flagging in the CBC/DIFF mode.

Calibration

Autocalibration

1. From the Main Menu, select **2. CALIBRATION ▸▸ 1. AUTOCALIBRATION**.
2. At the Autocalibration screen, change the lot number, expiration date, or target values as necessary.

Run Calibration

1. Prepare the calibrator according to the specific instructions (temperature, mixing, and so forth).
2. Open the vial and submerge the sample probe inside the vial.
3. Press the aspirate switch located behind the probe.
4. When the cycle LED stops flashing, remove the vial and replace the cap on the calibrator.
5. When the analysis cycle ends, the result is displayed.

IMPORTANT The calibration of the AC•T 5diff hematology analyzer can be performed on 3 to 11 analyses. To obtain the best calibration possible, it is recommended to run the calibration blood a minimum of five times. The autocalculation module performs statistics on these results to obtain the best calibration factors.

---

6. Remix the calibrator and repeat steps 2 through 5 until at least three, but no more than 11 calibrator samples are analyzed. It is recommended that you run the calibrator at least five times to achieve the best calibration.

   Note: After three runs, the instrument calculates calibration statistics.

Calibration Passed

Calibration passes if the statistics are within the acceptable limits:

- Coefficient of variation (CV) is within the limits setup as described.
- The percentage difference between the target and the mean value is less than 20.

1. At the instrument keypad,
   a. Press **Enter** to save the new calibration factors.
   b. Press **Enter** again to print the new calibration factors.
2. Check that the calibration factors are within the acceptable ranges listed in Table A.1-7.

Step-By-Step Cycle Check

Use this step-by-step description of the cycle as a guide to help you verify proper instrument operation at the end of a service call. This check covers the four principal phases of a cycle:

1. Sample preparation (making the dilutions)
2. Count and measurement of the WBC group
3. RBC/PLT group count
4. Filling the diluent reservoir

A special cycle is required when no other cycle is started during RBC/PLT count or during the filling of the diluent reservoir: rinsing of the RBC bath.

All phases are described in this procedure. Use Figures A.3-1 and A.3-2 If you need help locating an assembly.

Preparation

1. Remove the four hex screws securing the left side panel to the instrument frame and set the door aside.
2. If you have not already done so, change the User mode to Service. This bypasses the right side door interlock so you can cycle with the right side door open.

   From the Service menu, select **9. OTHERS ▸▸ 1. USER MODE**. For details, see User Mode under Heading 4.1.
3. Open the right side door.

Instrument At Rest

When the A^{C}•T 5diff analyzer is at rest (power is ON but the instrument is not cycling), verify:

1. The sample probe is in its home position and the green LED is glowing.
2. In the right compartment, verify all the baths (except the rinse chamber) are filled with diluent and the piston inside the waste syringe is up.
3. Inside the left compartment, verify the pistons inside the count syringe, 5diff syringe, and reagent syringes assemblies are down.

Note: It will be necessary to cycle a whole-blood specimen several times to see the following actions.

Sample Preparation (Making the Dilutions)

WARNING Risk of personal injury. When SERVICE is selected as the User mode, the right side door interlock is bypassed allowing instrument operation with the right side door open. Avoid any unnecessary contact with the sample probe. The probe is sharp and may contain biohazardous materials. When the service call is complete, make sure the interlock is reactivated to ensure the Customer is not accidently injured by the sample probe or its movement.

Verify sample probe movement and dilution preparation:

- ☐ Press the aspirate switch. All the baths are drained (waste syringe).
- ☐ 53 µL whole-blood sample is aspirated (sample syringe).
- ☐ Sample probe moves over the rinse chamber (sample probe, probe motor, traverse motor).
- ☐ 3 µL sample aliquot at the tip of the sample probe is discarded into the rinse chamber as the exterior of the sample probe is rinsed (sample syringe, diluent reagent syringe).
- ☐ Sample probe moves from the rinse chamber to the first dilution (DIL1/HGB) bath (sample probe motor, traverse motor).
- ☐ 10 µL of whole-blood partitioned for making the first dilution is delivered to the DIL1/HGB bath using a tangential flow of 1.7 mL of diluent (sample syringe, diluent reagent syringe). Mixing bubbles enter the bath. This is the primary 1:170 dilution (or first dilution).
- ☐ Sample probe moves from the first dilution (DIL1/HGB) bath to the WBC/BASO bath (sample probe motor, traverse motor).
- ☐ 10 µL of whole-blood partitioned for making the WBC/BASO dilution is delivered to the WBC/BASO bath using a tangential flow of 2.0 mL of WBC Lyse (sample syringe, WBC Lyse reagent syringe). Mixing bubbles enter the bath. This is a 1:200 dilution.
- ☐ Sample probe moves from the WBC/BASO bath to the DIFF bath (sample probe motor, traverse motor).
- ☐ 25 µL of whole-blood partitioned for making the DIFF dilution is delivered to the DIFF bath using a tangential flow of 1.0 mL of Fix reagent (sample syringe, Fix reagent syringe). Mixing bubbles enter the bath.
- ☐ Sample probe moves from the DIFF bath to the rinse chamber (sample probe motor, traverse motor).
- ☐ 5 µL of residual blood is expelled during the double rinsing (interior and exterior) of the sample probe (sample syringe, diluent reagent syringe).
- ☐ After 12 seconds of incubation, the dilution inside the DIFF bath is completed by adding another 1.0 mL of diluent which stops the cytochemical reaction (5diff syringe).

  Making the DIFF dilution detailed:

  - Sample probe is positioned opposite the entry port for the Fix reagent.
  - Solenoid valve 8 is energized which also sets up the reagent syringes assembly movement to dispense 1.0 mL of Fix reagent.
  - 25 µL of whole-blood sample is simultaneous delivered to the DIFF bath.
  - Solenoid valve 8 de-energizes.
  - DIFF dilution incubates for 12 seconds.
  - Solenoid valves 1 and 3 are energized which sets up the 5diff syringe to dispense 1.0 mL of diluent is added to the DIFF bath to stop the cytochemical reaction.
  - Solenoid valves 1 and 3 are de-energized.

Making the second dilution for RBC and PLT analysis:

- ☐ Sample probe moves from the rinse chamber the first dilution (DIL1/HGB) bath (sample probe motor, traverse motor).
- ☐ 42.5 µL of the primary 1:170 dilution is aspirated (sample syringe).
- ☐ Sample probe exterior is rinsed (in the first dilution bath) with 0.4 mL of diluent (diluent reagent syringe).
- ☐ Sample probe moves from the first dilution (DIL1/HGB) bath to the RBC bath (sample probe motor, traverse motor).
- ☐ 42.5 µL of the first 1:170 dilution is delivered to the RBC bath using a tangential flow of 2.0 mL of diluent (sample syringe, diluent reagent syringe). The tangential flow of reagent mixes the 1:170 dilution sample and the diluent to make a uniform suspension of cells. Mixing bubbles also enter the bath. This is the final RBC/Plt dilution.
- ☐ An additional 0.5 mL of diluent is dispensed through the probe at the end of the second dilution.

Hemoglobin measurement:

- ☐ Once the 42.5 µL of dilution is removed, the exterior of the sample probe is rinsed with 0.4 mL of diluent. 0.4 mL of Hgb Lyse reagent is then dispensed into the first dilution (DIL1/HGB) bath. Mixing bubbles enter the bath. The Hgb Lyse reagent destroys the red blood cells and converts a substantial proportion of the hemoglobin to a stable pigment so a hemoglobin value can be determined on the final 1:250 dilution.

Count and Measurement of the WBC Group

DiffPlot acquisition and WBC count:

- ☐ Loading of the vacuum injection circuit of the optical bench (waste syringe, energized solenoid valves 4 and 5).
- ☐ Start flow in the flow cell (approximately 2 seconds).
- ☐ Injection into the flow cell is 15 seconds but acquisition of data for the DiffPlot and WBC count occurs only 12 seconds.

Simultaneously, the WBC and BASO counts are gathered.

- ☐ Rinse of the counting head (the dilution pushed into position, solenoid valves 9, 10, 21, 23 and 13 are energized).
- ☐ Start the vacuum and first part of count (duration of 6 seconds, solenoid valve 23 energized).
- ☐ Rinsing of counting head and adjustment of the vacuum count.
- ☐ Second part of count (duration of 6 seconds).

After this first series of measurements:

- ☐ Measurement of the hemoglobin.
- ☐ Rinsing of the WBC/BASO bath with a mixture of 1.06 mL of Rinse reagent and 1.44 mL of diluent.
- ☐ Rinsing of the WBC/BASO counting head.

RBC/PLT Group Count

- ☐ Rinsing the RBC/PLT counting head.
- ☐ Start the vacuum for the RBC/PLT counting head.
- ☐ First series of counts (duration of 5 seconds, solenoid valve 14 energized).
- ☐ Rinsing of the RBC/PLT counting head and adjustment of the vacuum.
- ☐ Second series of counts (duration of 5 seconds).

Permanent Rinse Flow (PRF)

- ☐ The WBC/BASO and the RBC/PLT counting heads are *in series* during the RBC/PLT count. The count flow from the WBC bath circulates in the RBC/PLT counting head and limits the possibility of the circulation of the RBC behind the count orifice.
- ☐ The PRS functions similar to the autocleaning function in that it acts like a cleaning solution being drawn through the WBC/BASO aperture during the entire duration of the RBC and PLT counts.

Filling of Diluent Reservoir

- ☐ At the end of the RBC/PLT count, the RBC count vacuum is used for filling the diluent reservoir. Solenoid valves 15 and 25 are energized.
- ☐ To improve the filling speed, the syringe is initialized for a few seconds then drawn again to complete the filling.
- ☐ A float located in the tank controls the level of liquid.

Completing the Cycle

- ☐ To maximize mechanical resources, rinsing the RBC bath is normally programmed for the beginning of the succeeding cycle (which can be started during the RBC and PLT count).
- ☐ If no other cycle is started during the RBC/PLT count or during the filling of the diluent reservoir, a special rinsing sequence is initiated:
  - The sample signal light changes to red and the instrument is unavailable for a few seconds.
  - This sequence also involves draining of the RBC bath followed with a refilling with the diluent.

Wrap Up

1. Replace the left side panel. Secure the panel using the four hex screws removed earlier.
2. Close the right side door.
3. Make sure the right side door interlock is reactivated. See User Mode under Heading 4.1, as needed.
4. Turn the instrument off for 5 seconds then turn the instrument back on. An automatic Startup routine and background check is performed.
5. When the Startup and background checks are complete, verify the results are acceptable.

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6.1 ENGINEERING SCHEMATIC DRAWINGS

This chapter contains a variety of troubleshooting aids including fold-out engineering schematics and interconnect diagrams. Details concerning the instrument's pneumatic/hydraulic tubing and connections are also provided.

Because the engineering schematics are insserted into the document and are not assigned page numbers or figure numbers, they are not included in the table of contents or the index. In the text, they are referenced by their name.

Engineering Schematics

This chapter contains two schematics:

- Pneumatic/hydraulic schematic
- Interconnect schematic

The schematic revision levels were current on the date this revision of the manual was released. They will be updated again to the latest revision level whenever this manual is revised.

Additional Pneumatic/Hydraulic Information

Tubings and Connectors

In addition to the pneumatic/hydraulic schematic, a listing of the tubings and connectors used in the instrument are detailed in Table 6.3-1. This table also includes part numbers.

Pneumatic/Hydraulic Circuit Connections

Table 6.3-2 details the connections within each circuit including the diameter and length of tubing needed to make the connection. Tubing part numbers can be located on Table 6.3-1.

Additional Interconnect Information

Some components on the interconnect engineering schematic are detailed in diagrams. These interconnect diagrams are located under Heading 6.5.

6.2 PNEUMATIC / HYDRAULIC SCHEMATIC

Layout

The pneumatic/hydraulic schematic for the A^{C}•T 5diff analyzer is laid out like the instrument. On the left side of the schematic are the assemblies you find in the left side compartment, including the count syringe, the 5diff syringe, the reagent syringes assembly, the flow cell, and the associated solenoid valves. The right side of the schematic shows the assemblies located behind the right side door, including the baths assembly, the diluent reservoir, the waste syringe, the sample syringe, and the sample probe and rinse block assembly.

Color Coding

The pneumatic/hydraulic schematic is color coded to correlate with the color used on the reagent labels. The arrangement of reagents bottles correlates with their arrangement inside the reagent compartment.

- A^{C}•T 5diff Rinse lines are blue.
- A^{C}•T 5diff Fix reagent lines are yellow.
- A^{C}•T 5diff Hgb Lyse reagent lines are orange.
- A^{C}•T 5diff WBC Lyse reagent lines are green.
- The A^{C}•T 5diff Diluent reagent lines are magenta.
- All waste lines are color-coded red.

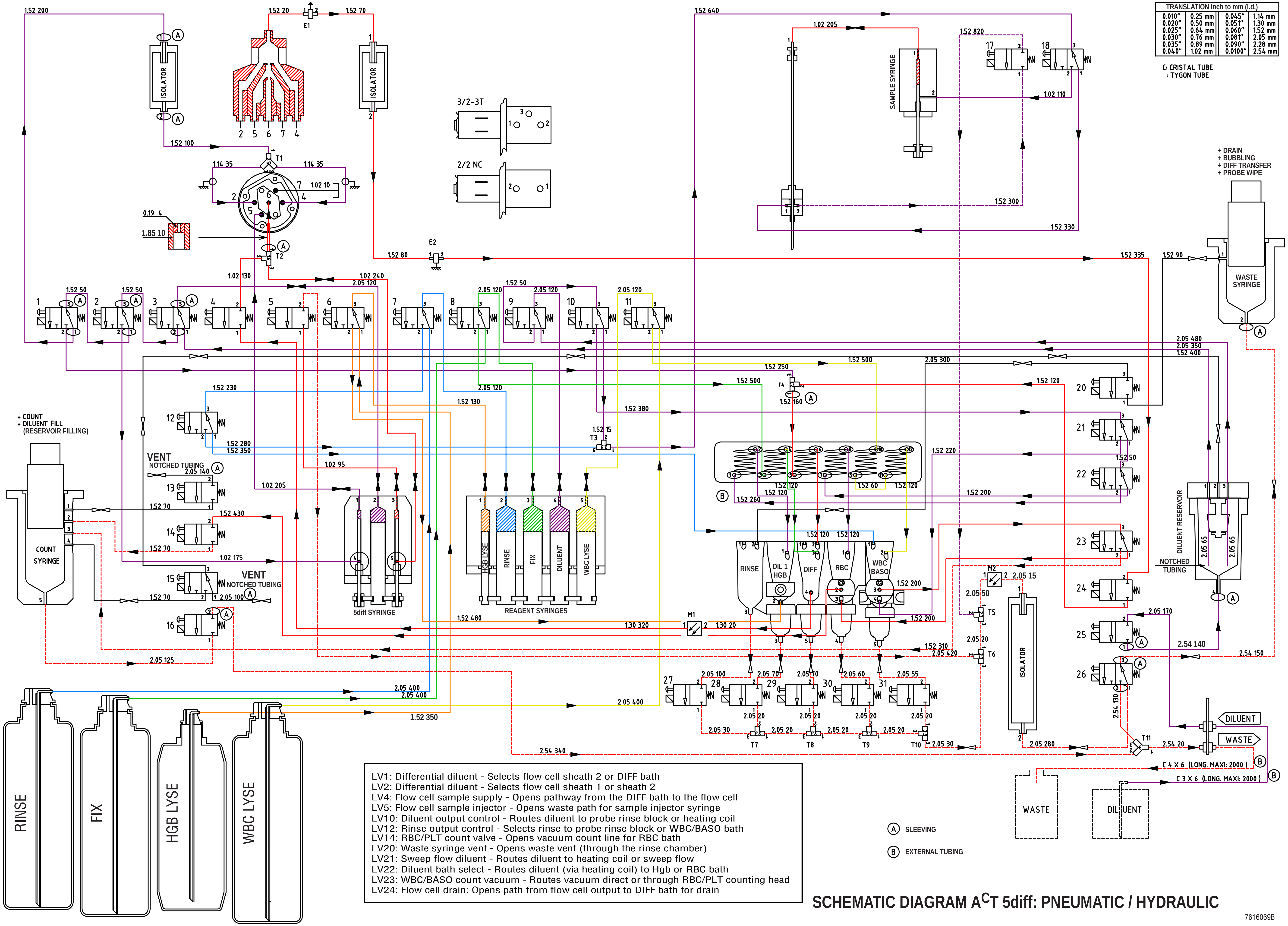
Tubing Designations

All tubing on this instrument is considered critical length. Notice there are two numbers associated with each tubing. The first number is the internal diameter of the tubing in millimeters; the second, is the length of the tubing in millimeters. For example, locate the count syringe. Notice the tubing attached to the bottom fitting also attaches to port 1 of solenoid valve 16. The number 2.05 125 is displayed above that line. This number indicates the tubing has a 2.05 mm diameter and is 125 mm long. A box containing a translation of inches to millimeter is located In the upper right corner. Although you may find this helpful, it does not contain all tubing measurements. The numbers will be close but, as in our example, not exact. Since the tubing is critical length, you may want to have a metric ruler available.

Most of the tubing used on this instrument is Tygon tubing. The legend in the upper right corner lists a second tubing, Cristal tubing which is used in limited quantities. In the lower right corner of the schematic, notice the waste container and the diluent container both use Cristal tubing. The Cristal tubing is designated by the letter C. The tubing used for the waste line has a larger diameter (4 mm) than the tubing used for the diluent (3 mm). These tubings are not interchangeable.

Solenoid Valves

Two types of solenoid valves are used on this instrument, a normally-closed two-way valve and a three-way valve. Inside the box to the right of the reagent bottle, LV designates the electronic valve or solenoid valve. Valve numbers may also be preceded by a V, an S, and an SL designation.


ISOLATOR
3/2-3T
2/2 NC
SAMPLE SYRINGE
+ DRAIN
+ BUBBLING
+ DIFF TRANSFER
+ PROBE WIPE
WASTE SYRINGE
+ COUNT
+ DILUENT FILL
(RESERVOIR FILLING)
COUNT SYRINGE
VENT
NOTCHED TUBING
5diff SYRINGE
REAGENT SYRINGES
HGB LYSE
RINSE
FIX
DILUENT
WBC LYSE
DIL 1 HGB
DIFF
RBC
WBC BASO
DILUENT RESERVOIR
DILUENT
WASTE
C 4 X 6 (LONG. MAXI: 2000)
C 3 X 6 (LONG. MAXI: 2000)
M1
M2
E1
E2
T1
T2
T3
T4
T5
T6
T7
T8
T9
T10
T11
A SLEEVING
B EXTERNAL TUBING
7616069B

TRANSLATION Inch to mm (i.d.)			
0.010"	0.25 mm	0.045"	1.14 mm
0.020"	0.50 mm	0.051"	1.30 mm
0.025"	0.64 mm	0.060"	1.52 mm
0.030"	0.76 mm	0.081"	2.05 mm
0.035"	0.89 mm	0.090"	2.28 mm
0.040"	1.02 mm	0.0100"	2.54 mm

C: CRISTAL TUBE
: TYGON TUBE

LV1: Differential diluent - Selects flow cell sheath 2 or DIFF bath
LV2: Differential diluent - Selects flow cell sheath 1 or sheath 2
LV4: Flow cell sample supply - Opens pathway from the DIFF bath to the flow cell
LV5: Flow cell sample injector - Opens waste path for sample injector syringe
LV10: Diluent output control - Routes diluent to probe rinse block or heating coil
LV12: Rinse output control - Selects rinse to probe rinse block or WBC/BASO bath
LV14: RBC/PLT count valve - Opens vacuum count line for RBC bath
LV20: Waste syringe vent - Opens waste vent (through the rinse chamber)
LV21: Sweep flow diluent - Routes diluent to heating coil or sweep flow
LV22: Diluent bath select - Routes diluent (via heating coil) to Hgb or RBC bath
LV23: WBC/BASO count vacuum - Routes vacuum direct or through RBC/PLT counting head
LV24: Flow cell drain: Opens path from flow cell output to DIFF bath for drain

SCHEMATIC DIAGRAM A^{C}T 5diff: PNEUMATIC / HYDRAULIC

6.3 PNEUMATIC/HYDRAULIC TUBINGS AND CONNECTIONS

Tubings and Connectors List

The tubings and connectors used in the A^{C}•T 5diff hematology analyzer are detailed in Table 6.3-1. This table also includes part numbers.

Table 6.3-1 Instrument Tubing and Connectors

Designation	Part Number	Diameter	Length	Quantity
Y-connector	EAB021A	3		1
Y-connector	EAB026A	2.5		1
T410 connector	EAB033A	1.6		1
T220 connector	EAB035A	2.3		8
0.040" Tygon® tubing	EAE005A	1.02	10	1
0.040" Tygon tubing	EAE005A	1.02	95	1
0.040" Tygon tubing	EAE005A	1.02	110	1
0.040" Tygon tubing	EAE005A	1.02	130	1
0.040" Tygon tubing	EAE005A	1.02	175	1
0.040" Tygon tubing	EAE005A	1.02	205	2
0.040" Tygon tubing	EAE005A	1.02	240	1
0.051" Tygon tubing	EAE006A	1.30	20	1
0.051" Tygon tubing	EAE006A	1.30	140	1
0.051" Tygon tubing	EAE006A	1.30	320	1
0.060" Tygon tubing	EAE007A	1.52	15	1
0.060" Tygon tubing	EAE007A	1.52	20	1
0.060" Tygon tubing	EAE007A	1.52	50	4
0.060" Tygon tubing	EAE007A	1.52	60	1
0.060" Tygon tubing	EAE007A	1.52	70	4
0.060" Tygon tubing	EAE007A	1.52	80	1
0.060" Tygon tubing	EAE007A	1.52	90	1
0.060" Tygon tubing	EAE007A	1.52	100	1
0.060" Tygon tubing	EAE007A	1.52	120	6
0.060" Tygon tubing	EAE007A	1.52	130	1
0.060" Tygon tubing	EAE007A	1.52	160	1
0.060" Tygon tubing	EAE007A	1.52	200	4
0.060" Tygon tubing	EAE007A	1.52	220	1
0.060" Tygon tubing	EAE007A	1.52	230	1
0.060" Tygon tubing	EAE007A	1.52	250	2
0.060" Tygon tubing	EAE007A	1.52	280	1

Table 6.3-1 Instrument Tubing and Connectors *(Continued)*

Designation	Part Number	Diameter	Length	Quantity
0.060" Tygon tubing	EAE007A	1.52	300	1
0.060" Tygon tubing	EAE007A	1.52	310	1
0.060" Tygon tubing	EAE007A	1.52	330	1
0.060" Tygon tubing	EAE007A	1.52	335	1
0.060" Tygon tubing	EAE007A	1.52	350	2
0.060" Tygon tubing	EAE007A	1.52	380	1
0.060" Tygon tubing	EAE007A	1.52	400	1
0.060" Tygon tubing	EAE007A	1.52	430	1
0.060" Tygon tubing	EAE007A	1.52	480	1
0.060" Tygon tubing	EAE007A	1.52	500	2
0.060" Tygon tubing	EAE007A	1.52	640	1
0.060" Tygon tubing	EAE007A	1.52	820	1
0.081" Tygon tubing	EAE008A	2.05	15	1
0.081" Tygon tubing	EAE008A	2.05	20	8
0.081" Tygon tubing	EAE008A	2.05	30	2
0.081" Tygon tubing	EAE008A	2.05	50	1
0.081" Tygon tubing	EAE008A	2.05	55	1
0.081" Tygon tubing	EAE008A	2.05	60	1
0.081" Tygon tubing	EAE008A	2.05	65	2
0.081" Tygon tubing	EAE008A	2.05	70	2
0.081" Tygon tubing	EAE008A	2.05	100	1
0.081" Tygon tubing	EAE008A	2.05	100	1
0.081" Tygon tubing	EAE008A	2.05	120	5
0.081" Tygon tubing	EAE008A	2.05	125	1
0.081" Tygon tubing	EAE008A	2.05	140	1
0.081" Tygon tubing	EAE008A	2.05	170	1
0.081" Tygon tubing	EAE008A	2.05	280	1
0.081" Tygon tubing	EAE008A	2.05	300	1
0.081" Tygon tubing	EAE008A	2.05	350	1
0.081" Tygon tubing	EAE008A	2.05	400	3
0.081" Tygon tubing	EAE008A	2.05	420	1
0.081" Tygon tubing	EAE008A	2.05	480	1
0.045" Tygon tubing	EAE033A	1.14	35	2
0.100" Tygon tubing	EAE034A	2.54	20	1
0.100" Tygon tubing	EAE034A	2.54	130	1

Table 6.3-1 Instrument Tubing and Connectors *(Continued)*

Designation	Part Number	Diameter	Length	Quantity
0.100" Tygon tubing	EAE034A	2.54	140	1
0.100" Tygon tubing	EAE034A	2.54	150	1
0.100" Tygon tubing	EAE034A	2.54	340	1
0.0075" Tygon tubing	EAE047A	0.19	4	1
0.073" Tygon tubing	EAE049A	1.85	10	1
Sleeving	GAL098A			27
Tube shielding	XBA403A			1

Pneumatic/Hydraulic Circuit Connections

In this table, each circuit connection has several descriptions. As you review the table, you will notice that many of the descriptions have a name or number, followed by a line, followed by a number. LV13_1 is a typical example of this format. LV13_1 is read as port 1 of valve 13 or valve 13, port 1.

Table 6.3-2 Circuit Connections

Circuit	From	F.S.	Diameter	Length	T.S.	To
AIR	Atmosphere		2.05	140		LV13_2
	LV13_1		1.52	70		Count syringe_1
	Atmosphere		2.05	100		LV15_1
	LV15_3		1.52	400		Diluent reservoir_2
	LV15_2		1.52	70		Count syringe_4
	Rinse_2 chamber (Atmosphere)		2.05	300		LV20_2
	LV20_1		1.52	90		Waste syringe_1

Table 6.3-2 Circuit Connections *(Continued)*

Circuit	From	F.S.	Diameter	Length	T.S.	To
DILUENT REAGENT	Diluent Input		2.05	170		LV25_2
	LV25_1	S	2.54	140	S	Diluent reservoir_4
			2.05	65		Diluent reservoir_1
	Diluent reservoir_1		2.05	350		LV3_1
	LV3_3	S	2.05	120		Injector syringe_2
	LV3_2	S	1.52	50	S	LV2_3
	LV2_1	S	1.52	50	S	LV1_3
	LV1_1	S	1.52	200	S	Isolator_1
	Isolator_2	S	1.52	100		T1_1
	T1_2		1.14	35		DIFF flow cell_4
	T1_2		xba403a			DIFF flow cell_4
	T1_3		1.14	35		DIFF flow cell_2
	T1_3		xba403a			DIFF flow cell_2
	LV1_2		1.52	250		T4_3
	LV2_2		1.02	175		Injector syringe_4
	Injector syringe_1		1.02	205		DIFF flow cell_5
	DIFF flow cell_7		1.02	10		(Cap)
			2.05	65		Diluent reservoir_3
	Diluent reservoir_3		2.05	480		LV9_1
	LV9_3		2.05	120		Reagent syringe_4
	LV9_2		1.52	50		LV10_3
	LV10_1		1.52	15		T3_2
	T3_1		1.52	640		LV18_3
	LV18_1		1.52	330		Probe rinse block_1
	Probe rinse block_2		1.52	300		LV17_1
	LV17_2		1.52	820		T5_2
	LV18_2		1.02	110		Sample syringe_2
	LV10_2		1.52	380		LV21_3
	LV21_1		1.52	50		
	LV22_1		1.52	200	S	Reagent heater_7
	Reagent heater_8	S	1.52	120		RBC bath_1
	LV22_2		1.52	250	S	Reagent heater_1
	Reagent heater_2	S	1.52	120		DIL1/HGB bath_1
	LV21_2		1.52	220		WBC/BASO bath_4

Table 6.3-2 Circuit Connections *(Continued)*

Circuit	From	F.S.	Diameter	Length	T.S.	To
RINSE REAGENT	Rinse reagent bottle		2.05	400		LV7_1
	LV7_3		2.05	120		Reagent syringe_2
	LV7_2		1.52	230		LV12_3
	LV12_1		1.52	350		WBC/BASO bath_1
	LV12_2		1.52	280		T3_3
FIX REAGENT	Fix reagent bottle		2.05	400		LV8_1
	LV8_3		2.05	120		Reagent syringe_3
	LV8_2		1.52	500	S	Reagent heater_3
	Reagent heater_4	S	1.52	120		DIFF bath_3
WBC LYSE REAGENT	WBC Lyse reagent bottle		2.05	400		LV11_1
	LV11_3		2.05	120		Reagent syringe_5
	LV11_2		1.52	500	S	Reagent heater_10
	Reagent heater_9	S	1.52	60	S	Reagent heater_11
	Reagent heater_12	S	1.52	120		WBC/BASO bath_2
HGB LYSE REAGENT	Hgb Lyse reagent bottle		1.52	350		LV6_1
	LV6_3		1.52	130		Reagent syringe_1
	LV6_2		1.52	480		DIL1/HGB bath_2
SAMPLING	Probe_1		1.02	205		Sample syringe_1
DIFF COUNTING	DIFF bath_4		1.30	20		M1_2 photocell
	M1_1 photocell		1.30	320		LV4_1
	LV4_2		1.02	130		T2_2
	T2_3		1.02	240		Injector syringe_5
	Injector syringe_3		1.02	95		LV5_1
	LV5_2		2.05	420		T6_2
	T2_1	S	1.85	10		DIFF flow cell_6
			0.19	4		DIFF flow cell_6
	DIFF flow cell_output		1.52	20		E1_1 anode fitting
	E1_2 anode fitting		1.52	70		Isolator_1
	Isolator_2		1.52	80		E2_1 ground fitting
	E2_2 ground fitting		1.52	335		LV24_2
	LV24_1		1.52	120		T4_2
	T4_1		1.52	160	S	Reagent heater_5
	Reagent heater_6	S	1.52	120		DIFF bath_2

Table 6.3-2 Circuit Connections *(Continued)*

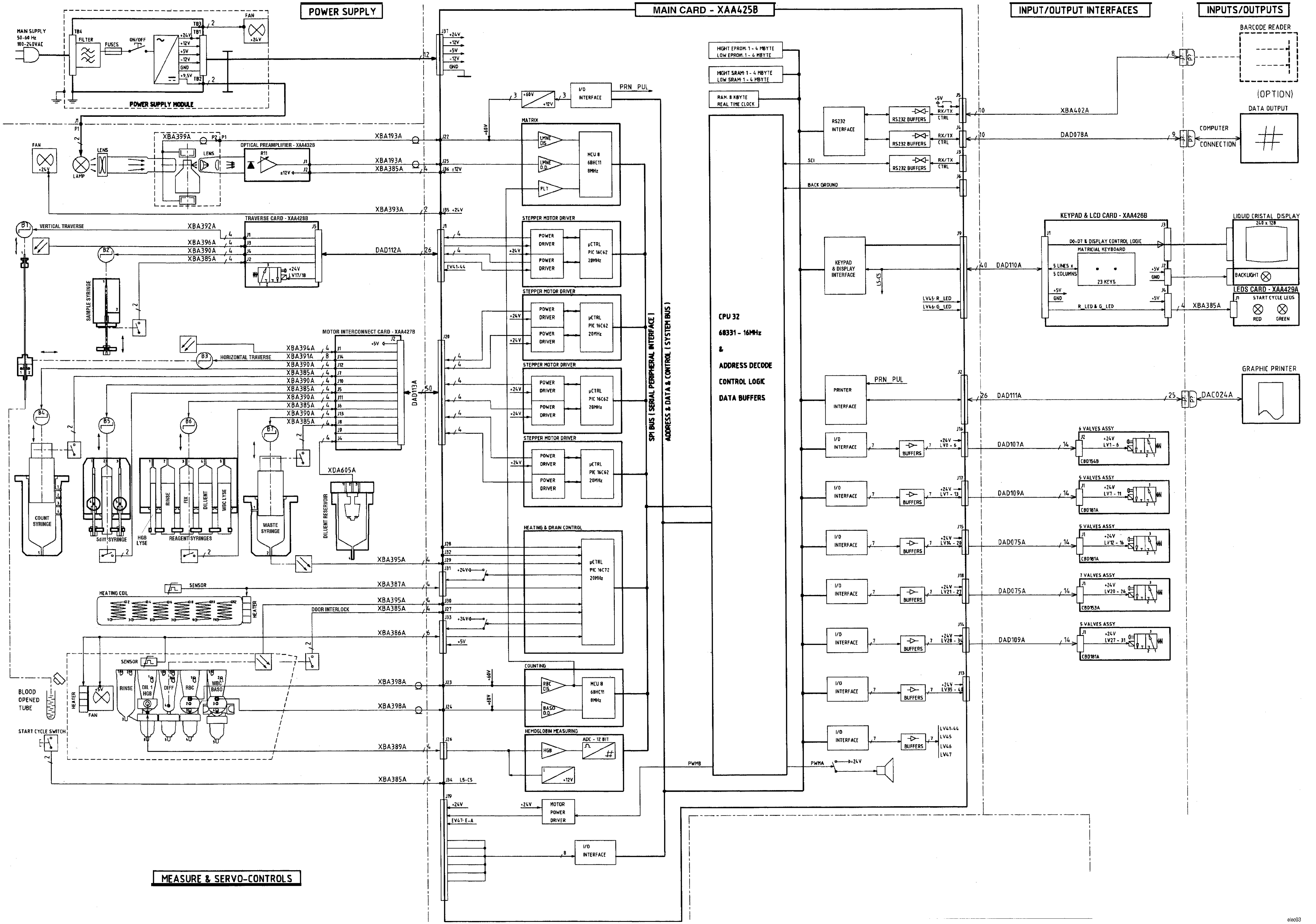
Circuit	From	F.S.	Diameter	Length	T.S.	To
WBC/RBC COUNTING	WBC/BASO bath_3		1.52	200		LV23_3
	LV23_1		1.52	200		RBC bath_3
	RBC bath_2		1.52	430		LV14_2
	LV14_1		1.52	70		Count syringe_2
	LV23_2		1.52	310		Count syringe_3
WASTE	Rinse chamber_3		2.05	100		LV27_2
	LV27_1		2.05	30		T7_3
	DIL1/HGB bath_3		2.05	70		LV28_2
	LV28_1		2.05	20		T7_2
	T7_1		2.05	20		T8_3
	DIFF bath_5		2.05	70		LV29_2
	LV29_1		2.05	20		T8_2
	T8_1		2.05	20		T9_3
	RBC bath_4		2.05	60		LV30_2
	LV30_1		2.05	20		T9_2
	T9_1		2.05	20		T10_2
	WBC/BASO bath_5		2.05	55		LV31_2
	LV31_1		2.05	20		T10_1
	T10_3		2.05	30		T6_3
	T6_1		2.05	20		T5_3
	T5_1		2.05	50		M2_1 photocell
	M2_2 photocell		2.05	15		Isolator_1
	Isolator_2		2.05	280		LV26_1
	LV26_3	S	2.54	150	S	Waste syringe_2
	LV26_2	S	2.54	130		T11_3
	Count syringe_5		2.05	125		LV16_1
	LV16_2	S	2.54	340		T11_2
	T11_1		2.54	20		Waste output

6.4 INTERCONNECT DIAGRAM

The fold-out interconnect diagram for the A^{C}•T 5diff analyzer is divided into five sections using a dash/dot line. These five sections include:

- Power Supply module in the upper left corner.
- Measurement components on the left, under the Power Supply module.
- Main card in the center.
- Input/output interfaces to the right of the Main card.
- System inputs and outputs.

This interconnect diagram is a helpful troubleshooting tool, especially when troubleshooting an electronic problem.


POWER SUPPLY
MAIN CARD - XAA425B
INPUT/OUTPUT INTERFACES
INPUTS/OUTPUTS
MAIN SUPPLY 50-60 Hz 100-240VAC
TB4
FILTER
FUSES
ON/OFF
TB3
TB1
TB2
FAN
+24V
+12V
+5V
-12V
GND
+9,5V
POWER SUPPLY MODULE
J1
P1
J37
XBA399A
P2
OPTICAL PREAMPLIFIER - XAA432B
R11
LENS
LAMP
±12V
XBA193A
XBA385A
XBA393A
J22
J25
J36 ±12V
J35 +24V
+60V
+12V
I/O INTERFACE
PRN PUL
MATRIX
LMNE CIS
LMNE D.D
PLT
MCU 8 68HC11 8MHz
TRAVERSE CARD - XAA428B
VERTICAL TRAVERSE
XBA392A
XBA396A
XBA390A
DAD112A
EV41-44
LV17/18
STEPPER MOTOR DRIVER
POWER DRIVER
μCTRL PIC 16C62 20MHz
SAMPLE SYRINGE
MOTOR INTERCONNECT CARD - XAA427B
XBA394A
XBA391A
HORIZONTAL TRAVERSE
DAD113A
J20
XDA605A
DILUENT RESERVOIR
COUNT SYRINGE
5diff SYRINGE
HGB LYSE
RINSE
FIX
DILUENT
WBC LYSE
REAGENT SYRINGES
WASTE SYRINGE
HEATING & DRAIN CONTROL
μCTRL PIC 16C72 20MHz
XBA395A
XBA387A
SENSOR
HEATING COIL
HEATER
DOOR INTERLOCK
XBA386A
J28
J32
J29
J31
J30
J27
J33
COUNTING
RBC CIS
BASO D.D
XBA398A
J23
J24
BLOOD OPENED TUBE
DIL 1 HGB
DIFF
RBC
WBC BASO
HEMOGLOBIN MEASURING
ADC - 12 BIT
HGB
XBA389A
J26
START CYCLE SWITCH
J34 LS-CS
J19
EV47-E-A
MOTOR POWER DRIVER
PWMB
MEASURE & SERVO-CONTROLS
SPI BUS (SERIAL PERIPHERAL INTERFACE)
ADDRESS & DATA & CONTROL (SYSTEM BUS)
HIGHT EPROM 1 - 4 MBYTE
LOW EPROM 1 - 4 MBYTE
HIGHT SRAM 1 - 4 MBYTE
LOW SRAM 1 - 4 MBYTE
RAM 8 KBYTE REAL TIME CLOCK
CPU 32
68331 - 16MHz
&
ADDRESS DECODE
CONTROL LOGIC
DATA BUFFERS
RS232 INTERFACE
RS232 BUFFERS
RX/TX CTRL
SCI
BACK GROUND
KEYPAD & DISPLAY INTERFACE
LS-CS
LV45: R_LED
LV46: G_LED
PRINTER INTERFACE
PWMA
BUFFERS
+24V LV0 - 6
+24V LV7 - 13
+24V LV14 - 20
+24V LV21 - 27
+24V LV28 - 34
+24V LV35 - 40
LV41-44
LV45
LV46
LV47
XBA402A
DAD078A
BARCODE READER
(OPTION)
DATA OUTPUT
COMPUTER CONNECTION
KEYPAD & LCD CARD - XAA426B
DC-DT & DISPLAY CONTROL LOGIC
MATRICIAL KEYBOARD
5 LINES x 5 COLUMNS
23 KEYS
R_LED & G_LED
DAD110A
LIQUID CRISTAL DISPLAY 240 x 128
BACKLIGHT
LEDS CARD - XAA429A
START CYCLE LEDS
RED
GREEN
GRAPHIC PRINTER
DAD111A
DAC024A
6 VALVES ASSY
LV1 - 6
CBD154B
DAD107A
5 VALVES ASSY
LV7 - 11
CBD181A
DAD109A
LV12 - 16
DAD075A
7 VALVES ASSY
LV20 - 26
CBD153A
LV27 - 31
elec03

6.5 MOTORS AND CABLES

Figure 6.5-1 Horizontal Traverse Motor (PN - XBA391A)

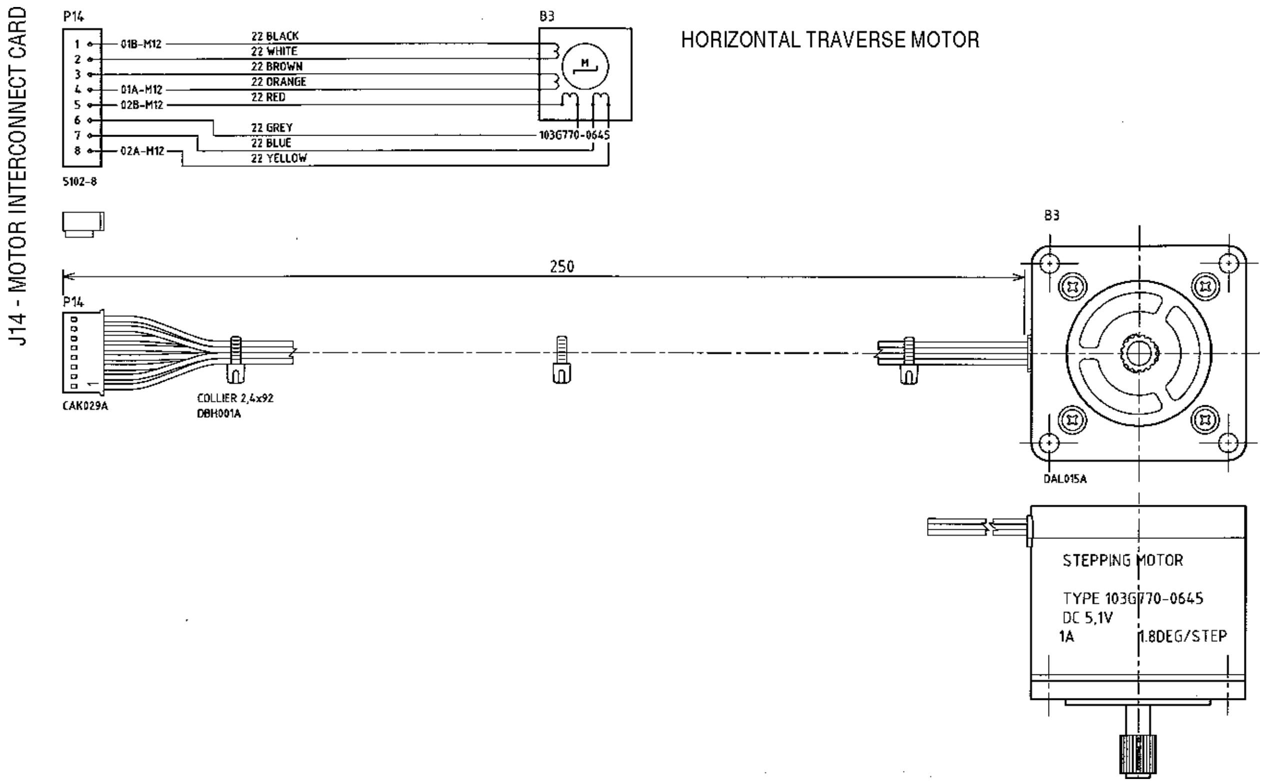

J14 - MOTOR INTERCONNECT CARD
P14
B3
HORIZONTAL TRAVERSE MOTOR
1
2
3
4
5
6
7
8
01B-M12
01A-M12
02B-M12
02A-M12
22 BLACK
22 WHITE
22 BROWN
22 ORANGE
22 RED
22 GREY
22 BLUE
22 YELLOW
M
103G770-0645
5102-8
250
P14
CAK029A
COLLIER 2,4x92
DBH001A
B3
DAL015A
STEPPING MOTOR
TYPE 103G770-0645
DC 5,1V
1A
1.8DEG/STEP

Figure 6.5-2 Upper Fan (PN - XBA393A)

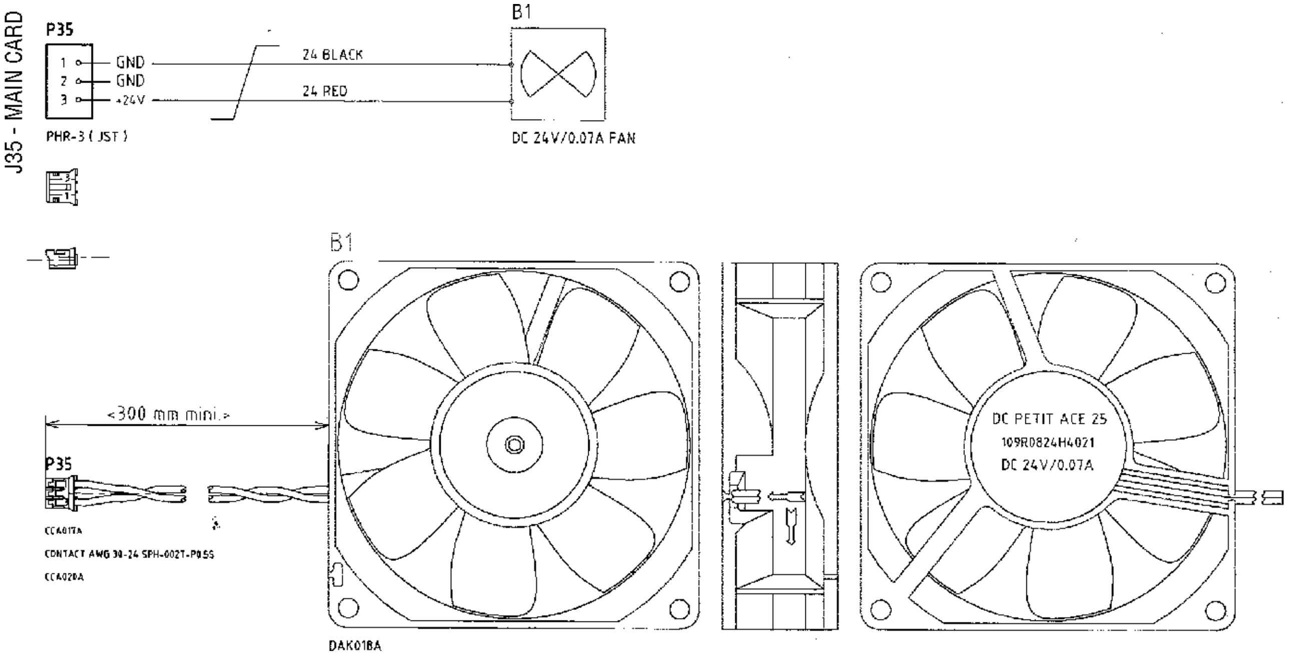

J35 - MAIN CARD
P35
1 GND
2 GND
3 +24V
PHR-3 (JST)
24 BLACK
24 RED
B1
DC 24V/0.07A FAN
B1
<300 mm mini.>
P35
CCA017A
CONTACT AWG 30-24 SPH-002T-P0.5S
CCA020A
DAK01BA
DC PETIT ACE 25
109R0824H4021
DC 24V/0.07A

Figure 6.5-3 Horizontal Traverse Sensor (IR Sensor, PN - XBA394AS)

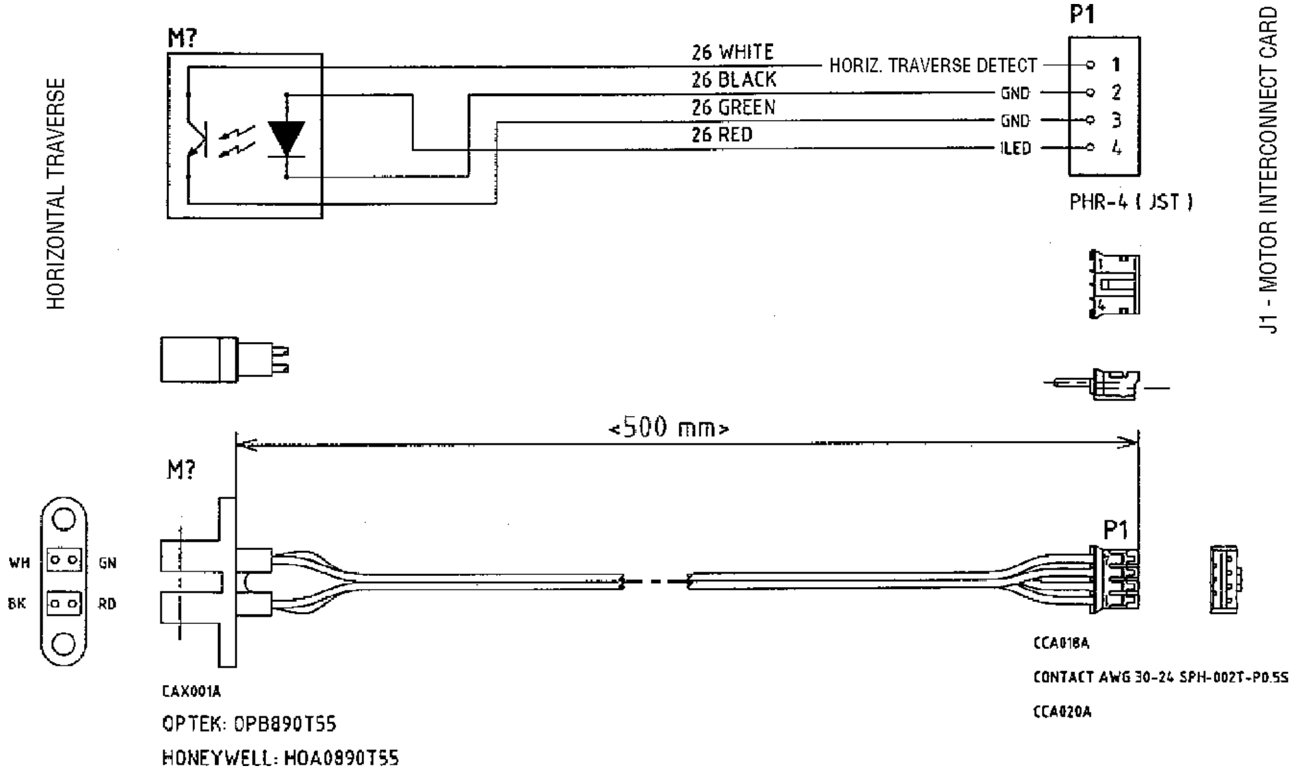
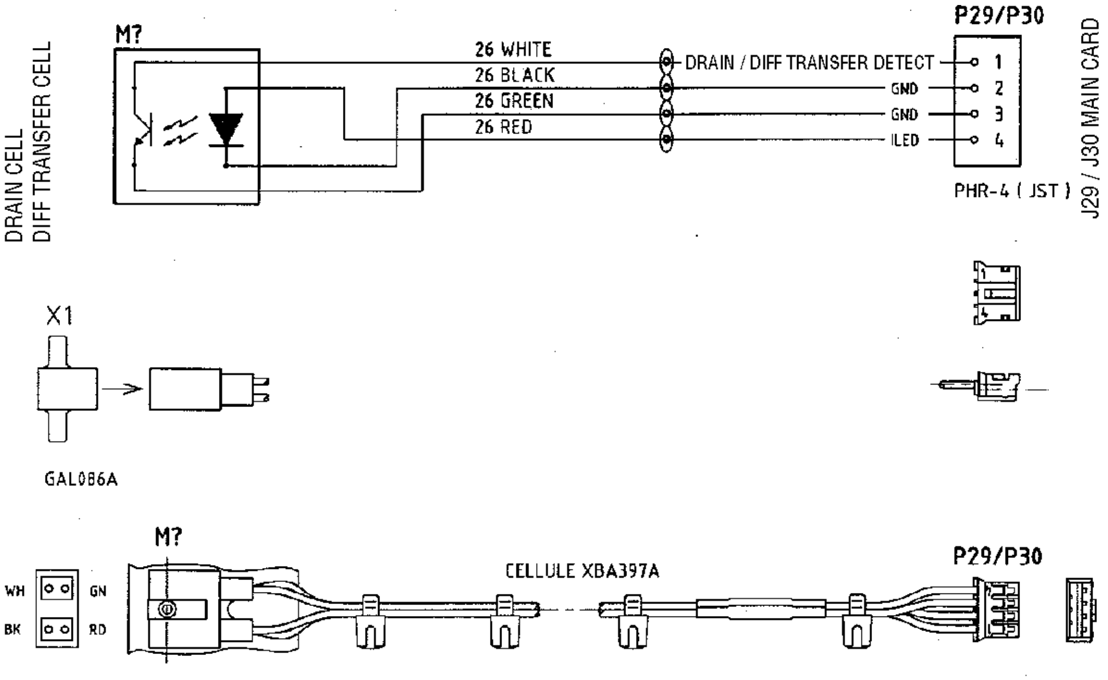

HORIZONTAL TRAVERSE
M?
26 WHITE
26 BLACK
26 GREEN
26 RED
HORIZ. TRAVERSE DETECT
GND
GND
ILED
P1
1
2
3
4
PHR-4 (JST)
J1 - MOTOR INTERCONNECT CARD
<500 mm>
M?
WH
GN
BK
RD
P1
CAX001A
OPTEK: OPB890T55
HONEYWELL: HOA0890T55
CCA018A
CONTACT AWG 30-24 SPH-002T-P0.5S
CCA020A

Figure 6.5-4 Bath Drain and DIFF Transfer Sensor (IR Sensor, PN - XBA395AS)


DRAIN CELL
DIFF TRANSFER CELL
M?
26 WHITE
26 BLACK
26 GREEN
26 RED
DRAIN / DIFF TRANSFER DETECT
GND
GND
ILED
P29/P30
1
2
3
4
PHR-4 (JST)
J29 / J30 MAIN CARD
X1
GAL086A
M?
WH
BK
GN
RD
CELLULE XBA397A
P29/P30

REP.	NB	DESIGNATION
M?	1	GAINE THERMO. ADH. Ø12.7 x 30

Figure 6.5-5 Vertical Traverse Sensor (IR Sensor, PN - XBA396AS)

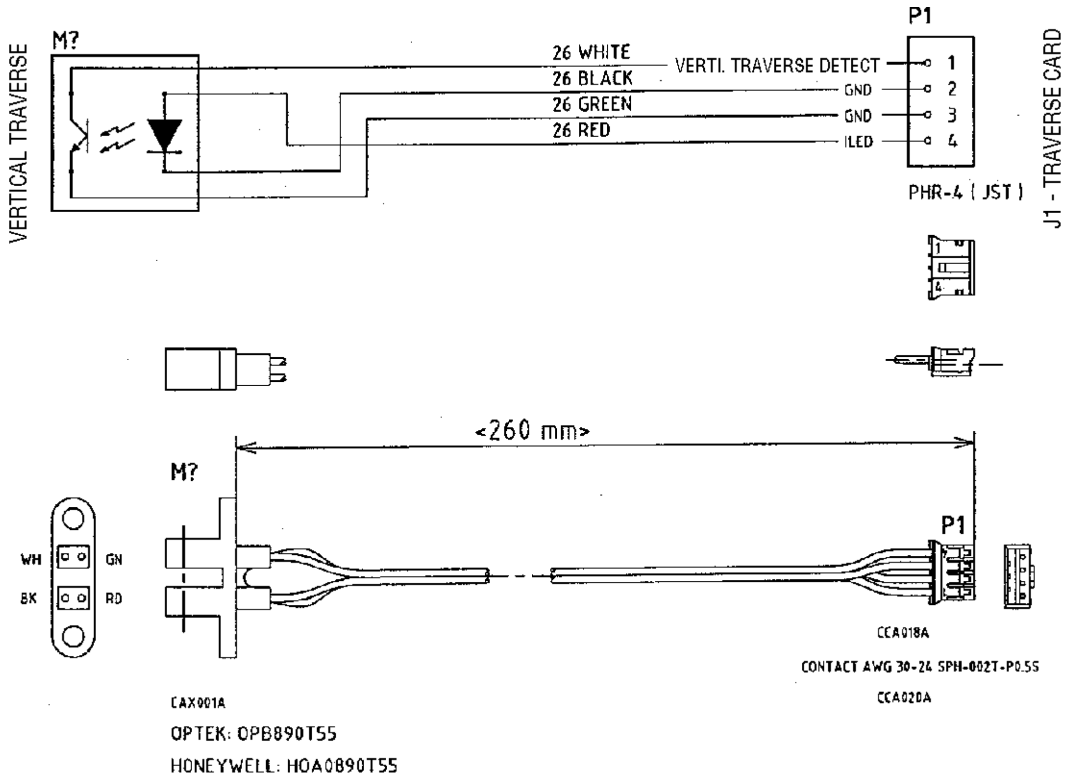
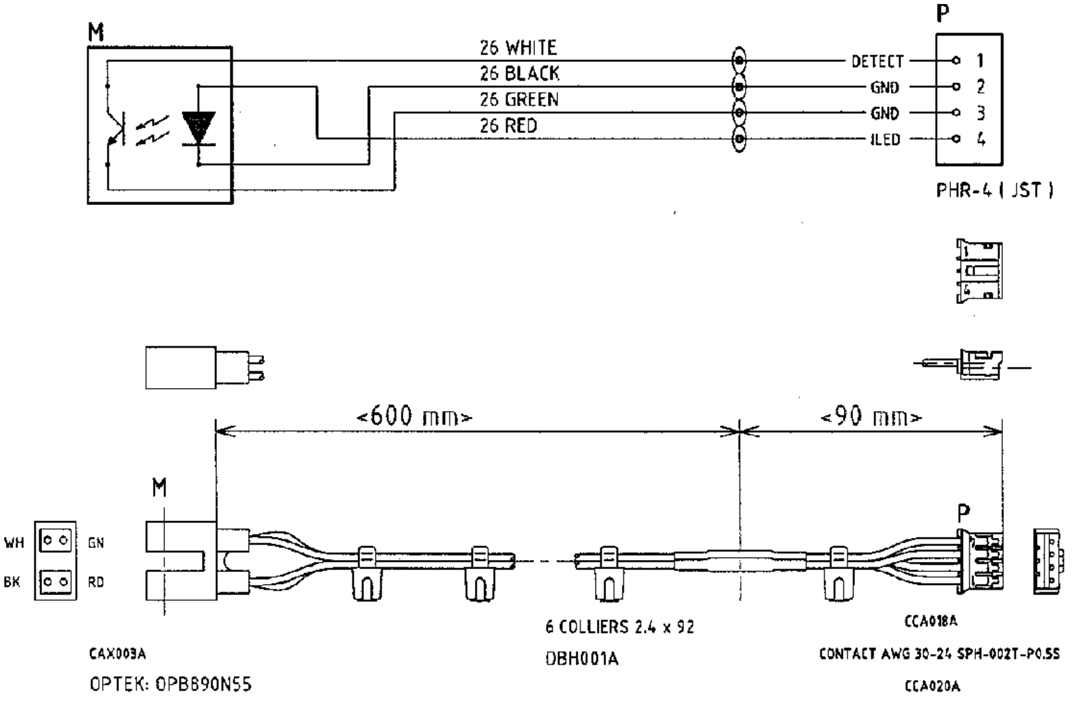

VERTICAL TRAVERSE
M?
26 WHITE
26 BLACK
26 GREEN
26 RED
VERTI. TRAVERSE DETECT
GND
GND
ILED
P1
1
2
3
4
PHR-4 (JST)
J1 - TRAVERSE CARD
1
4
<260 mm>
M?
WH
GN
BK
RD
P1
CCA018A
CONTACT AWG 30-24 SPH-002T-P0.5S
CCA020A
CAX001A
OPTEK: OPB890T55
HONEYWELL: HOA0890T55

Figure 6.5-6 IR Sensor (PN - XBA397AS)


M
26 WHITE
26 BLACK
26 GREEN
26 RED
DETECT
GND
GND
ILED
P
1
2
3
4
PHR-4 (JST)
<600 mm>
<90 mm>
M
P
WH
BK
GN
RD
6 COLLIERS 2.4 x 92
0BH001A
CCA018A
CONTACT AWG 30-24 SPH-002T-P0.5S
CCA020A
CAX003A
OPTEK: OPB890N55
HONEYWELL: HOA0890N55

REP.	NB	DESIGNATION
EPISSURES	4	GAINE THERMO. Ø1.6 X 20

Figure 6.5-7 RBC/WBC Coaxial Cable (PN - XBA398A)

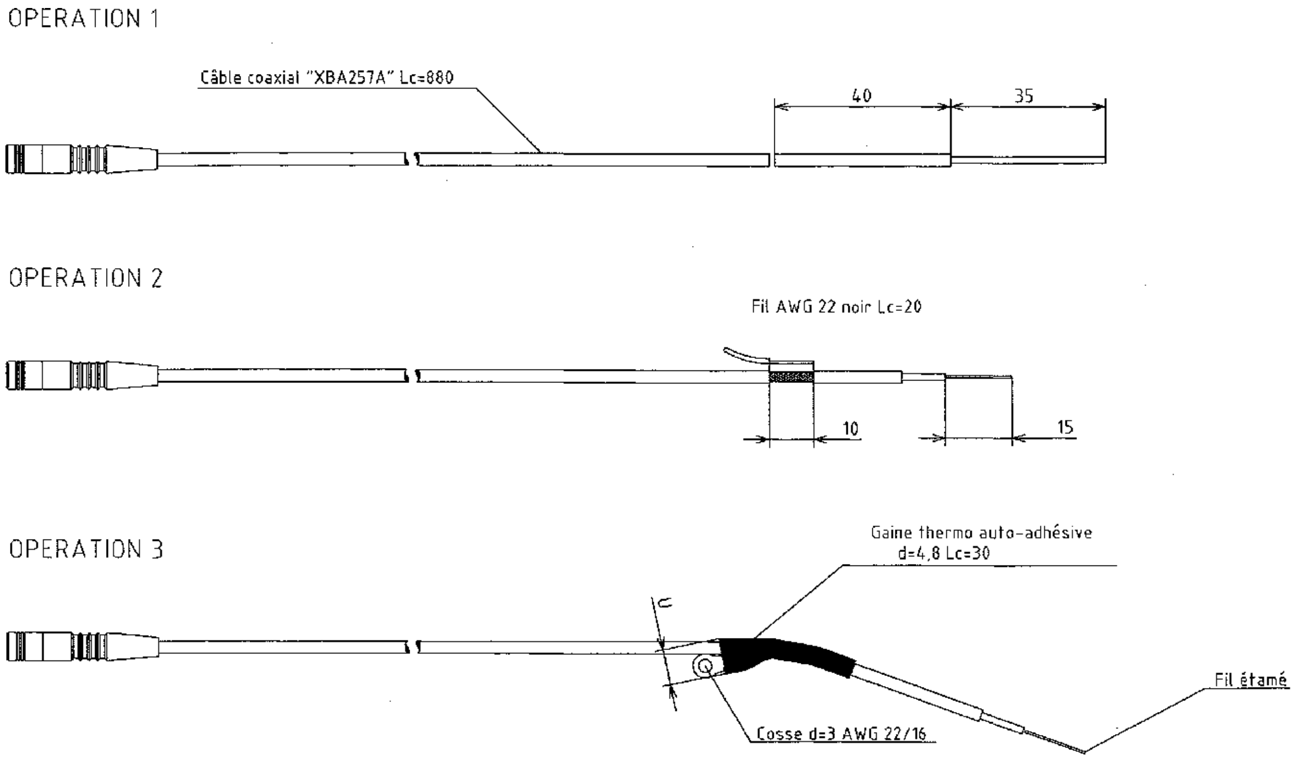
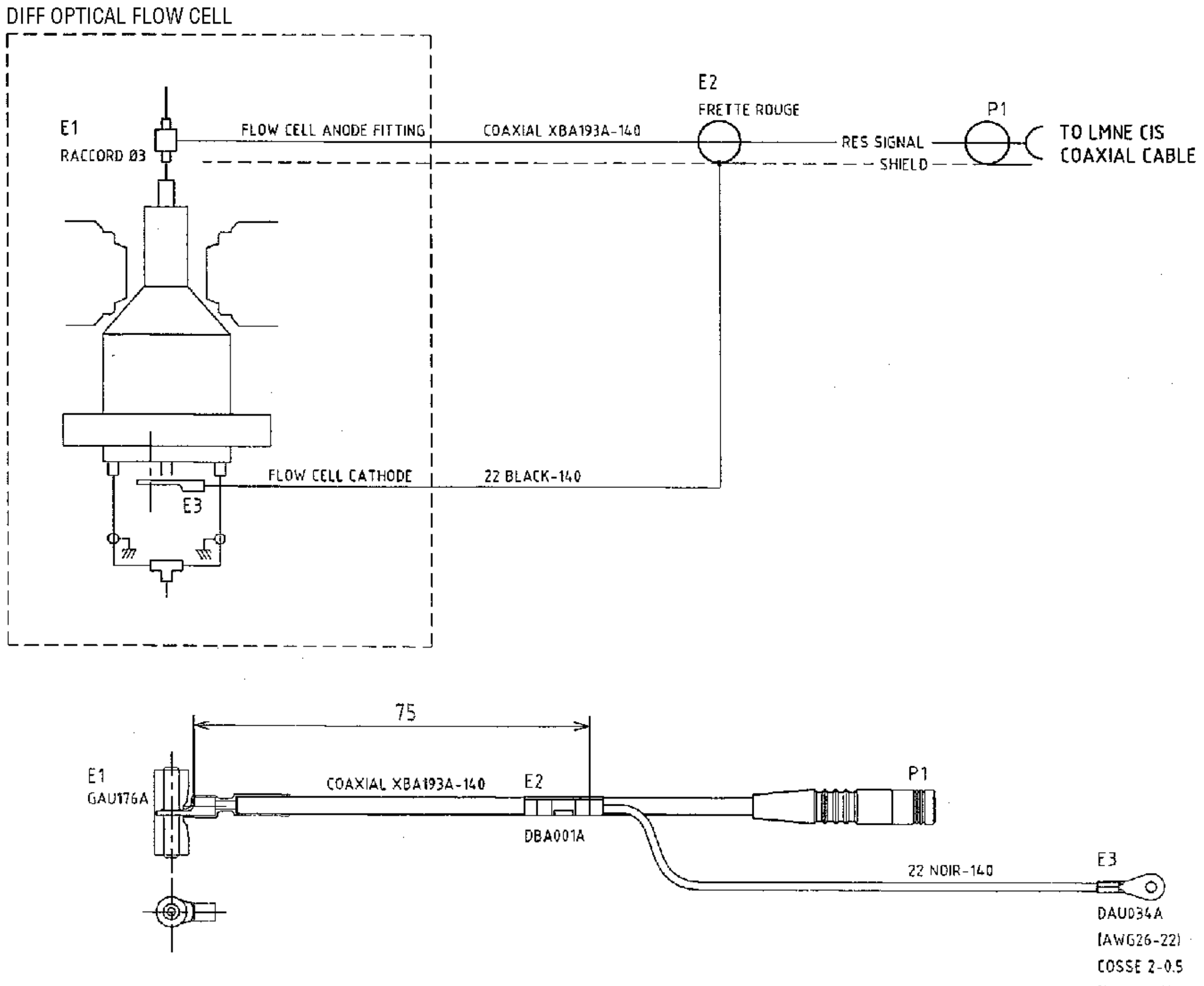
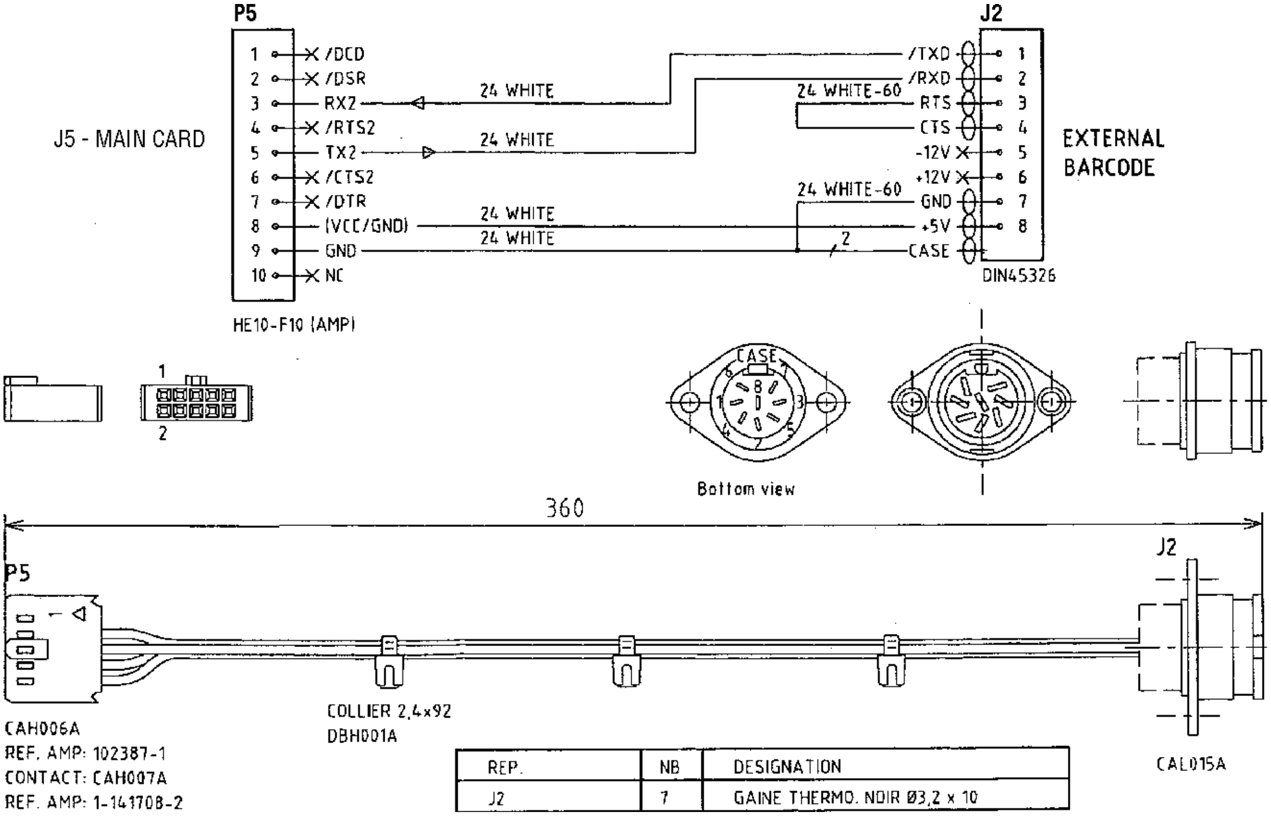

OPERATION 1
Câble coaxial "XBA257A" Lc=880
40
35
OPERATION 2
Fil AWG 22 noir Lc=20
10
15
OPERATION 3
Gaine thermo auto-adhésive
d=4,8 Lc=30
Cosse d=3 AWG 22/16
Fil étamé

Figure 6.5-8 DIFF Flow Cell Coaxial Cable (PN - XBA399AS)


DIFF OPTICAL FLOW CELL
E1
RACCORD Ø3
FLOW CELL ANODE FITTING
COAXIAL XBA193A-140
E2
FRETTE ROUGE
RES SIGNAL
SHIELD
P1
TO LMNE CIS
COAXIAL CABLE
FLOW CELL CATHODE
22 BLACK-140
E3
75
E1
GAU176A
COAXIAL XBA193A-140
E2
DBA001A
P1
22 NOIR-140
E3
DAU034A
(AWG26-22)
COSSE 2-0.5
(DIN46237)

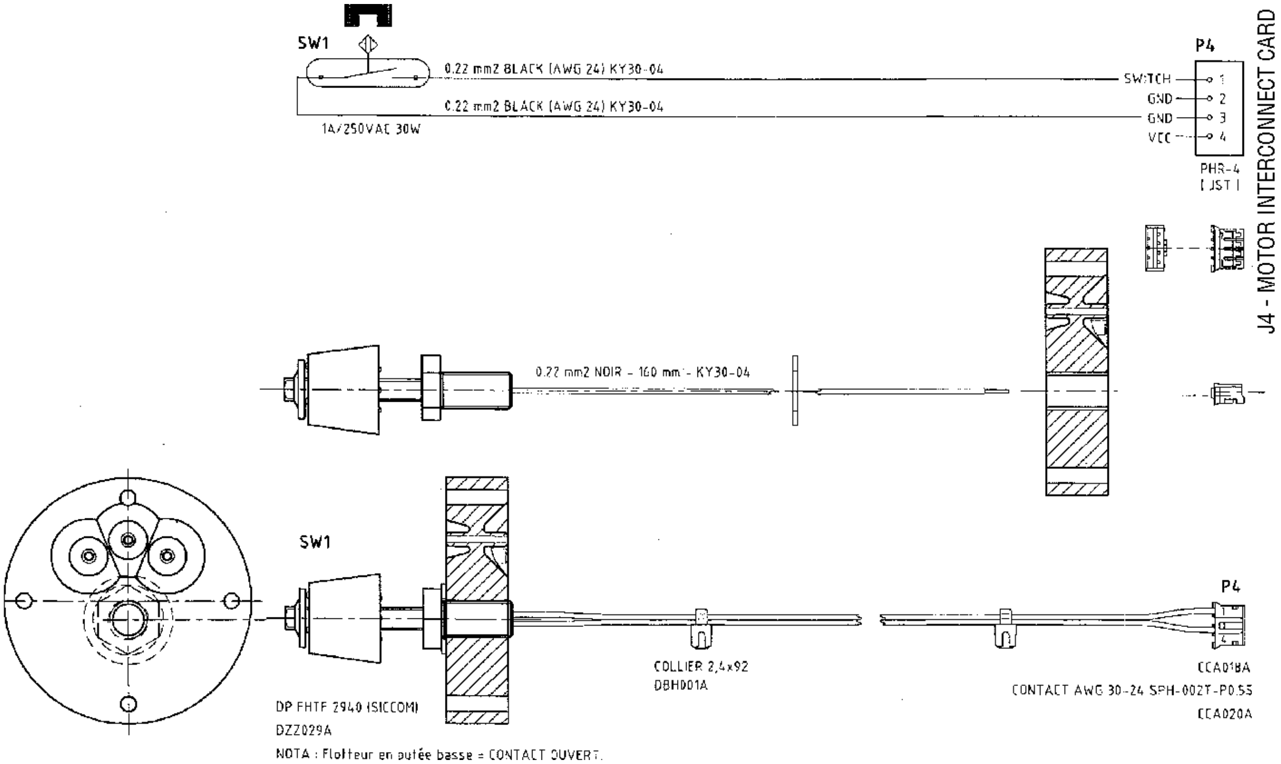
REP.	NB	DESIGNATION
E1	1	GAINE THERMO. NOIR Ø3,2 × 20
E1	1	MANCHON HPS3, Lc=16

Figure 6.5-9 Bar-Code Reader Cable (PN - XBA402AS)


P5
J2
J5 - MAIN CARD
1 /DCD
2 /DSR
3 RX2
4 /RTS2
5 TX2
6 /CTS2
7 /DTR
8 (VCC/GND)
9 GND
10 NC
24 WHITE
24 WHITE
24 WHITE
24 WHITE
24 WHITE-60
24 WHITE-60
2
/TXD 1
/RXD 2
RTS 3
CTS 4
-12V 5
+12V 6
GND 7
+5V 8
CASE
EXTERNAL
BARCODE
DIN45326
HE10-F10 (AMP)
1
2
CASE
8
1
2
3
4
5
6
7
Bottom view
360
P5
J2
CAH006A
REF. AMP: 102387-1
CONTACT: CAH007A
REF. AMP: 1-141708-2
COLLIER 2,4x92
DBH001A
CAL015A

REP.	NB	DESIGNATION
J2	7	GAINE THERMO. NOIR Ø3,2 x 10

Figure 6.5-10 Diluent Level Sensor (PN - XDA605AS)


SW1
0.22 mm2 BLACK (AWG 24) KY30-04
0.22 mm2 BLACK (AWG 24) KY30-04
1A/250VAC 30W
P4
SWITCH
GND
GND
VCC
1
2
3
4
PHR-4
[JST]
J4 - MOTOR INTERCONNECT CARD
0.22 mm2 NOIR - 160 mm - KY30-04
SW1
P4
COLLIER 2,4x92
DBH001A
CCA018A
CONTACT AWG 30-24 SPH-002T-P0.5S
CCA020A
DP FHTF 2940 (SICCOM)
DZZ029A
NOTA : Flotteur en butée basse = CONTACT OUVERT.

7 **TROUBLESHOOTING, 7.1-1**

7.1 ERROR MESSAGES, 7.1-1

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To Only Check Motors in the Left Side Compartment, 7.2-2
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Preparation, 7.3-1
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To Only Check Valves in the Right Side Compartment, 7.3-1
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ILLUSTRATIONS

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7.3-2 Valves 17 and 18 Location, 7.3-2
7.3-3 Valves 20 through 31 Locations, 7.3-2

TABLES

7.1-1 Error Messages, 7.1-1

7.1 ERROR MESSAGES

Table 7.1-1 Error Messages

Displayed Message	Problem	Corrective Action
AT LEAST 3 TAGGED RESULTS REQUIRED	At least 3 results are required for calibration calculations and less than 3 have been run.	Run at least three results for calculation results to be generated.
BATH ENCLOSURE DOOR OPENED	If a cycle is attempted while the right side door is open, this message is generated.	Close door to continue.
DATA NOT SAVED, VALUE OUT OF RANGE	The value typed in is not an acceptable value. It may be out of an expected range or an incorrect data type.	Re-enter the data
DRAIN TIMEOUT	Draining problems.	1. Run a System Reset cycle. 2. If the problem persists, call your Beckman Coulter Representative.
ENTER AN IDENTIFICATION	An ID is required to run an analysis in the Manual ID mode.	Enter the specimen ID.
INCORRECT DATE ENTRY	The value entered is not a valid date.	Enter a valid date.
INCORRECT TIME ENTRY	The time entered is not a valid time.	Enter a valid time.
NO ACK CHARACTER RECEIVED ON RS232	There is a problem with the communication or handshaking to the host computer.	Check that the protocol that has been set up in the host transmission screen matches the protocol expected by the host computer.
NO DILUENT, CHECK LEVEL	The diluent reservoir is not able to fill.	Check the diluent level and replace diluent if necessary.
NO ENQ CHARACTER RECEIVED ON RS232	There is a problem with the communication or handshaking to the host computer.	Check that the protocol that has been setup in the host transmission screen matches the protocol expected by the host computer.
PRINTER ERROR, CHECK PAPER	An error indication has been sent from the Printer to the instrument, usually a paper out message.	1. Ensure there is paper in the Printer. 2. Check the Printer user's manual for other Printer errors.
REAGENT LOW LEVEL [REAGENT NAME]	The calculated reagent level for the specified reagent indicates no reagent.	1. Check the reagent level and replace the reagent if necessary. 2. Update the reagent level.
REAGENTS LOW LEVEL	This message is given at the end of startup if there is not enough reagent left to complete the daily workload that has been set up.	Monitor the reagent levels, or change the reagents and update the levels.

Table 7.1-1 Error Messages *(Continued)*

Displayed Message	Problem	Corrective Action
SYSTEM ERROR, RUN SYSTEM RESET CYCLE	During a cycle, a system error of the following type has caused the system to stop: • A motor has not returned to its home sensor when expected. • A drain problem has been detected at one of the two drain sensors. • The right side door has been opened during a cycle, losing temperature control at the baths.	1. Check the specified motor to make sure it is not jammed, and there are no signs of physical damage to motor mechanism or sensor. 2. Check the bath compartment for leaks, plugs, loose tubing. Ensure that there is sufficient reagent and that the system is primed. 3. Ensure that there is no physical damage to the microswitch that senses closure of the right side door and that the door is completely closed. 4. Run an System Reset cycle after checking/correcting any instrument problems.
TEMPERATURE OUT OF RANGE	The temperature in the counting bath compartment is outside of the acceptable range.	1. Ensure the sure right side door is closed. 2. Wait a few minutes. 3. If problem persists, call your Beckman Coulter Representative.
THE PRINTER IS DISCONNECTED, SWITCHED OFF, OR HAS NOT BEEN SELECTED	No or incorrect communication between Printer and instrument	1. Ensure the cable is properly connected. 2. Ensure the Printer is turned on. 3. Ensure the Printer is online or selected.
TIMEOUT OVERFLOW ON RS232	There is a problem with the communication or handshaking to the host computer.	Check that the protocol that has been setup in the host transmission screen matches the protocol expected by the host computer.
USER PASSWORD	A password is required to perform the requested action.	Enter user password.
WRITE ERROR ON RS232	There is a problem with the communication or handshaking to the host computer.	Check that the protocol that has been set up in the host transmission screen matches the protocol expected by the host computer.
XXX NOT REACHING HOME **Note:** XXX = name of motor.	Motor did not reach home sensor.	

7.2 CHECKING THE MOTORS

Purpose

Use this procedure to individually verify motor operation is smooth and regular for one or more of seven different stepper motors including the:

Note: If you need help locating the various assemblies, see Figures A.3-1 and A.3-2. These figures show the assembly the motor controls, not the actual motor being checked.

- **Sample probe motor**. This motor is responsible for moving the sample probe up and down. This is also called the vertical traverse motor. You can verify operation of this motor without opening any compartments.
- **Traverse motor.** This motor is responsible for the left/right movement of the sample probe (inside its housing) over the baths assembly. This motor is also called the horizontal traverse motor. You need to access the right side compartment to verify operation of this motor.
- **Sample syringe motor.** This motor is responsible for aspirating, partitioning, and delivering the proper volume of sample. You need to access the right side compartment to verify operation of this motor by observing the sample syringe piston movement.
- **Waste syringe motor.** This motor is responsible for the draining the baths and various chambers. It also provides mixing bubbles and the vacuum needed to pull the DIFF specimen from the DIFF bath towards the flow cell injector syringe. You need to access the right side compartment to verify operation of this motor by observing waste syringe piston movement.
- **Count syringe motor.** This motor is responsible for supplying the aperture vacuum needed for counting as well as the vacuum needed to fill the diluent reservoir. You need to access the left side compartment to verify operation of this motor by observing count syringe piston movement.
- **5diff syringe motor.** This motor is responsible for the correct proportioning of the stop diluent in the DIFF bath and for injecting the sample into the flow cell. You need to access the left side compartment to verify operation of this motor by observing 5diff syringe piston movement.
- **Reagent syringes motor.** This motor is responsible for the correct distribution of the different reagents including Hgb Lyse, Rinse, Fix, Diluent, and WBC Lyse. You need to access the left side compartment to verify operation of this motor by observing the piston movements of the reagent syringes.

Tools/Supplies Needed

☐ Allen wrenches, 2.5 mm and 3.0 mm , may be required.

Preparation

Determine which motor(s) you want to check so you know which door to open or panel to remove.

To Check All Motors

1. Open the right side door.
2. Remove the left side panel and set it aside. For details, see Heading 4.2.

CAUTION A flat cable is connected to the rear of the Main card. Be careful when you open the door (where the Main card is attached) that you do not disconnect or damage this cable.

---

3. In the left side compartment,
    a. Turn the two captive knobs counterclockwise to release the Main card door. These knobs are located to the right of the Main card.
    b. Open the Main card door and carefully anchor the door behind the white plastic catch to keep it open.
4. Go to the Motors Check heading that follows.

To Only Check Motors in the Right Side Compartment

To check the sample probe, traverse assembly, sample syringe, or waste syringe motor:

1. Open the right side door of the instrument.
2. Go to the Motors Check heading that follows.

To Only Check Motors in the Left Side Compartment

To check the count syringe, 5diff syringe, or reagent syringes motor:

1. Remove the left side panel and set it aside. For details, see Heading 4.2.

CAUTION A flat cable is connected to the rear of the Main card. Be careful when you open the door (where the Main card is attached) that you do not disconnect or damage this cable.

---

2. In the left side compartment,
    a. Turn the two captive knobs counterclockwise to release the Main card door. These knobs are located to the right of the Main card.
    b. Open the Main card door and carefully anchor the door behind the white plastic catch to keep it open.
3. Go to the Motors Check heading that follows.

Motors Check

1. From the Main Menu, select **DIAGNOSTICS ▸▸ HARDWARE SYSTEMS ▸▸ MOTORS.**

Note: Motors must be checked individually. If more than one motor needs checked, select one motor and verify its operation before proceeding to the next.

2. From the Motors menu, select the motor you want to check:
   1. SAMPLING PROBE (same as Vertical Traverse or Sample Probe)
   2. TRAVERSE (same as Horizontal Traverse)
   3. SAMPLING SYRINGE (same as Sample Syringe)
   4. DRAINING SYRINGE (same as Waste Syringe)
   5. COUNTING SYRINGE (same as Count Syringe
   6. FLOWCELL SYRINGES (same as 5diff Syringe)
   7. DILUTION SYRINGES (same as Reagent Syringes assembly)
3. Verify the motor is operating smoothly and regularly by observing the movement of the respective components. See Figures A.3-1 and A.3-2 if you need help locating these assemblies.
   - If checking the **SAMPLING PROBE** motor, make sure the sample probe is moving up and down properly (vertical traverse movement check).
   - If checking the **TRAVERSE** motor, make sure the left/right movement of the sample probe (inside its housing) over the baths assembly is correct (horizontal traverse movement check).
   - If checking the **SAMPLING SYRINGE** motor, make sure the sample syringe piston is moving up and down properly.
   - If checking the **DRAINING SYRINGE** motor, make sure the waste syringe piston is moving up and down properly.
   - If checking the **COUNTING SYRINGE** motor, make sure the count syringe piston is moving up and down properly.
   - If checking the **FLOWCELL SYRINGE** motor, make sure the 5diff syringe piston is moving up and down properly.
   - If checking the **DILUTION SYRINGES** motor, make sure all five syringe pistons in the reagent syringes assembly are moving up and down properly.

Wrap Up

When motor performance is acceptable, close all doors and panels:

1. If the right side compartment was opened, close the right side door.
2. If the left side compartment was opened,
   a. Close the Main card door. Turn the two captive knobs clockwise to secure the door.

ATTENTION: When replacing the left side panel with the instrument powered on, avoid accidently turning the instrument off again by carefully positioning the opening for the power on/off rocker switch over the switch as you position the panel on the instrument frame.

b. Replace the left side panel and install the four hex screws that secure it to the instrument frame.

7.3 CHECKING THE VALVES

Purpose

Use this procedure to verify a valve's operation is smooth and regular. When activated, all the valves in the assembly should be activated. There are five valve assemblies in the instrument including:

- One 11-valve assembly (valve numbers 1 through 11) located in the left side compartment.
- One 5-valve assembly (valve numbers 12 through 16) located in the left side compartment.
- One 2-valve assembly (valve numbers 17 and 18) located in the right side compartment.
- One 7-valve assembly (valve numbers 20 through 26) located in the right side compartment.
- One 5-valve assembly (valve numbers 27 through 31) located in the right side compartment.

Note: Valve 19 is not used on the A^{C}•T 5diff hematology analyzer.

Tools/Supplies Needed

☐ Allen wrenches, 2.5 mm and 3.0 mm, may be required.

Preparation

Determine which valve or valves you want to check so you know which door to open or panel to remove.

To Only Check Valves in the Left Side Compartment

To check one or more valves with a number 1 through 16:

1. Remove the left side panel and set it aside. For details, see Heading 4.2.

CAUTION A flat cable is connected to the rear of the Main card. Be careful when you open the door (where the Main card is attached) that you do not disconnect or damage this cable.

2. In the left side compartment,
   a. Turn the two captive knobs counterclockwise to release the Main card door. These knobs are located to the right of the Main card.
   b. Open the Main card door and carefully anchor the door behind the white plastic catch to keep it open.
3. Go to the Valves Check heading that follows.

To Only Check Valves in the Right Side Compartment

To check one or more valves with a number 17 or higher:

1. Open the right side door of the instrument.
2. Go to the Valves Check heading that follows.

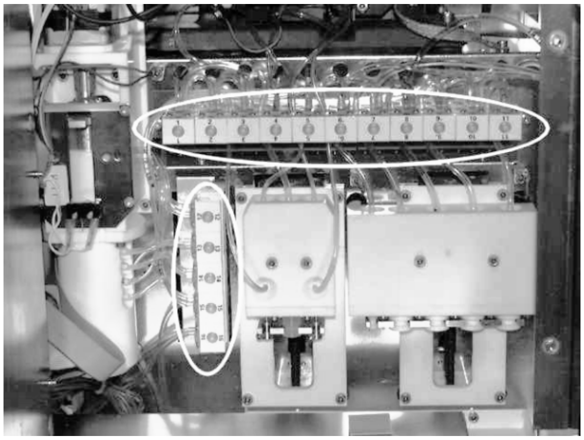
Valves Check

1. From the Main Menu, select **DIAGNOSTICS ▸▸ HARDWARE SYSTEMS ▸▸ VALVES**.
2. From the Valves menu, select the range of valves you want to check:

a. 1 to 11
b. 12 to 16

(Valves are located inside the left compartment.)

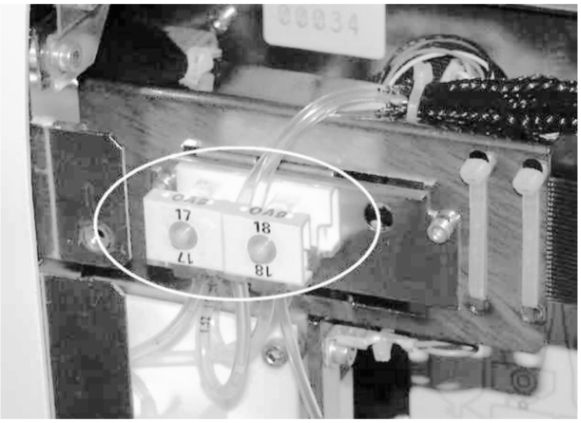
Figure 7.3-1 Valve 1 through 16 Locations



c. 17 and 18

(Valves are located inside the right compartment, just above the sample syringe assembly.)

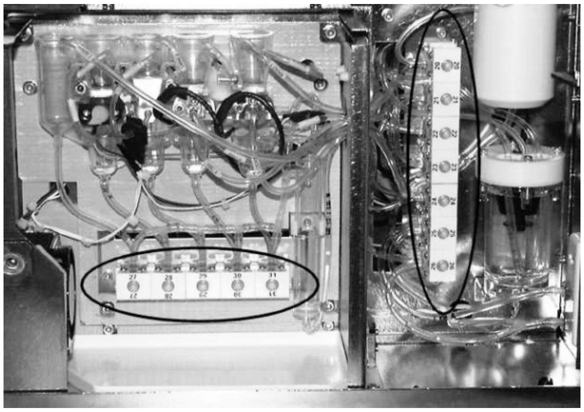
Figure 7.3-2 Valves 17 and 18 Location



d. 20 to 26
e. 27 to 31

(Valves are located inside the right compartment.)

Figure 7.3-3 Valves 20 through 31 Locations



Wrap Up

When valve performance is acceptable, close all doors and panels:

1. If the right side compartment was opened, close the right side door.
2. If the left side compartment was opened,
    a. Close the Main card door. Turn the two captive knobs clockwise to secure the door.

    ATTENTION: When replacing the left side panel with the instrument powered on, avoid accidently turning the instrument off again by carefully positioning the opening for the power on/off rocker switch over the switch as you position the panel on the instrument frame.

    b. Replace the left side panel and install the four hex screws that secure it to the instrument frame.

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8.1 MASTER PARTS LISTS

The parts listed in this section are divided into tables by category. Table 8.1-1 lists the categories and their table numbers.

Within each table the part numbers are listed in numeric order. When applicable, a component is cross referenced to its illustration in Heading 8.2.

Table 8.1-1 Part Categories

Category	Table	Category	Table
Return Parts	8.1-2	Waste Alarm Kit, PN - 6912680	8.1-9
Nonreturn Parts	8.1-3	6 Month Maintenance Kit, PN - XEA485AS	8.1-10
Peripherals, Accessories and Consumables	8.1-4	1 Year Maintenance Kit, PN - XEA486AS	8.1-11
Tools	8.1-5	Every 2 Years Maintenance Kit, PN - XEA581AS	8.1-12
Fitting Kit Parts PN - XEA311AS	8.1-6	100 mN-m Torque Driver Kit, - PN 6915456	8.1-13
Screws Kit Parts PN - XEA293AS	8.1-7	400 mN-m Torque Driver Kit, - PN 6915457	8.1-14
Installation Kit, PN - XEA484AS	8.1-8	Assorted Tools Kit, - PN 6915458	8.1-15

Table 8.1-2 Return Parts

Part Number	Description	Figure	Item
DBN004A	Power Supply, module		
XAA423BS	Preamp, optical signal assembly	8.2-40	1
XAA477CS	PCB, Main card (without software)		
XAA427BS	PCB, Motor interface card		
XAA461A	PCB, Keypad/LCD Display		
XDA600A	Optical bench, module		

Table 8.1-3 Nonreturn Parts

Part Number	Description	Figure	Item
1017413	Velcro (loop) strip, precut (2 in. x 1 in.), 2 each (used with installation of waste alarm)		
1017414	Velcro (hook) strip, precut (2 in. x 1 in.), 2 each (used with installation of waste alarm)		
3202035	Tubing, 035 clear polyurethane, 2-inch piece (used with installation of waste alarm)		
6011001	Tie wrap, small		
6011002	Tie wrap, large		
6216308	Feed-through fitting (used with installation of waste alarm)		
6912680	Waste alarm, kit. Table 8.1-9 lists the contents of this kit.		
CAE006A	Switch, microswitch XC5-81-82	8.2-42 8.2-44	3 3
CAE010A	Switch, microswitch XC5-81	8.2-8 8.2-16 8.2-22	7 7 5
CAY012A	LCD, display screen		
DAC011A	Cable, power, Europe		
DAC012A	Cable, power USA		
DAD113A	Cable, motor interface to Main Card		
DAJ007A	Lamp assembly for Optical module	8.2-38	1
DBK004A	Holder, adhesive, tie wrap, o.d.3 mm, package of 10		
DZZ015A	Ferrite shield (for printer cable)		
DZZ018A	Ferrite shield (for coax cables)		
EAC008A	Fitting, antirotation washer, package of 5	8.2-49	11
EAC010A	Fitting, Luer, female, i.d. 3 mm, package of 5	8.2-49	10
EAC019A	Fitting, Luer, male, i.d. 3 mm, package of 5		
EAE005AS	Tubing, Tygon, 1.016 mm i.d. (0.040 in.), 2 meter length		
EAE006AS	Tubing, Tygon, 1.295 mm i.d. (0.051 in.), 2 meter length		
EAE007AS	Tubing, Tygon, 1.52 mm i.d. (0.060 in.), 2 meter length		
EAE008AS	Tubing, Tygon, 2.05 mm i.d. (0.081 in.), 2 meter length	8.2-7	3
EAE011AS	Tubing, crystal, 3x6 mm (i.d. x o.d.), 10 meter length		
EAE028AS	Tubing, crystal, 4x6 mm (i.d. x o.d.), 2 meter length		
EAE034AS	Tubing, Tygon, 2.54 mm i.d. (0.100 in.), 2 meter length		
FAA040A	O-ring, 5diff syringe, 12.1 mm diameter, package of 10	8.2-15	2
FAA046A	O-ring, coaxial cable, package of 10		
FAA053A	O-ring, probe rinse block, package of 10	8.2-27	3
FAA064A	O-ring, sample syringe, package of 10	8.2-21	2
FAA065A	O-ring, reagent syringe, 6.3 mm diameter, package of 10	8.2-13	8

Table 8.1-3 Nonreturn Parts *(Continued)*

Part Number	Description	Figure	Item
FAA066A	O-ring, bath drain/debubble chamber, package of 12	8.2-46 8.2-48	10 10
FAA067A	O-ring, 5diff syringe, 2.4 mm diameter, package of 10	8.2-15	3
FAK001A	Aperture, RBC/Plt, 50 µ	8.2-46	4
FAK003A	Aperture, WBC/BASO, 80 µ	8.2-48	4
FAL009A	Nut, shock mount, for most subassemblies, package of 12	8.2-8 8.2-16 8.2-22	1 1 10
FAL010A	Nut, shock mount, for optics module, package of 12		
FAM004A	Foot, plastic, main chassis, package of 8		
FBL001A	Stopper, rubber with two holes, used for diluent pickup		
FBR011A	Belt, probe vertical, 364 tooth	8.2-30	1
FBR012A	Belt, traverse horizontal, 544 tooth	8.2-35	1
GAK302A	Cap, reagent bottle, 40 mm diameter, package of 12		
GAL094A	Chamber, diluent reservoir	8.2-7	4
GAL098A	Sleeve, tubing/fitting compression collar		
GBC015A	Clip, long isolator chamber holder, package of 10	8.2-45	6
GBC030A	Piston, reagent syringe, large	8.2-13	3
GBC031A	Piston, reagent syringe, lyse	8.2-13	7
GBG003A	Chamber, drain and debubble	8.2-46 8.2-48	12 12
GBG007A	Diffuser, drain and debubble, set of 4	8.2-46 8.2-48	11 11
GBG013A	Drip tray, overflow, bath enclosure		
GBG022A	Cover, bath enclosure		
GBG205A	Cover, solenoid drivers, bank 27-31	8.2-42	7
GBG033A	Syringe, reagent, body	8.2-13	1
GBG037A	Syringe, 5diff, body	8.2-15	1
GBG040A	Piston, 5diff syringe	8.2-15	5
GBG042A	Syringe, 5diff, O-ring collar	8.2-15	4
GBG044A	Syringe, sample, body	8.2-21	1
GBG048A	Syringe, sample, O-ring collar	8.2-21	3
GBG052A	Piston, count/waste syringe	8.2-11	4
GBG053A	Syringe, count, body	8.2-9	3
GBG054A	Syringe, waste, body	8.2-17	4
GBG090A	Sample probe, rinse block	8.2-27	2

Table 8.1-3 Nonreturn Parts *(Continued)*

Part Number	Description	Figure	Item
GBG091A	Sample probe, guide	8.2-27	4
GBG093A	Pulley, belt freewheel	8.2-31 8.2-36	4 3
GBG138A	Key, right side door		
GBG144A	Pickup, reagent bottle, 27 mm stopper		
GBG145A	Pickup, reagent bottle, 20 mm stopper		
GBG147A	Drip tray, reagents syringe		
GBG155A	Cap, reagent bottle, 25 mm diameter, package of 4		
GBG156A	O-ring, aperture, package of 12	8.2-46 8.2-48	5 5
GBG157A	Counting head (internal electrode)	8.2-46 8.2-48	7 7
GBG210A	Syringe body (new style)		
GBG211A	Chamber, counting syringe (new style)		
GBG212A	Chamber, drain syringe (new style)		
GBG219A	Anti-extrusion ring	8.2-9 8.2-17	5 5
GBG225A	Keypad, silicone		
HAE026B	Label, valves, 1-10, package of 10		
HAE027B	Label, valves, 11-20, package of 10		
HAE028B	Label, valves, 21-30, package of 10		
HAE029B	Label, valves, 31-40, package of 10		
HAX0012	Label, tubing, reagent lines		
HAX0013	Label, tubing, bath enclosure lines		
XAA468A	PCB, LED card, aspiration indicator	8.2-41	2
XBA144A	Cable, reagent ground fitting		
XBA193A	Cable, coaxial, flow cell optical		
XBA386A	Cable, bath enclosure harness		
XBA389A	Photometer, HGB diode and preamp assembly	8.2-47	4
XBA390A	Motor, for syringe assembly	8.2-10 8.2-18 8.2-22	1 1 1
XBA391A	Motor, traverse, horizontal	8.2-34	1
XBA392A	Motor, sample probe, vertical	8.2-31 8.2-32	9 1
XBA393A	Fan, main chassis, 24 V	8.2-49	6

Table 8.1-3 Nonreturn Parts *(Continued)*

Part Number	Description	Figure	Item
XBA394A	Sensor, traverse horizontal, home	8.2-36	7
XBA395A	Sensor, fluid, bath drain		
XBA396A	Sensor, sample probe vertical, home	8.2-33	1
XBA398B	Cable, coaxial, with RBC/WBC bath electrode	8.2-46 8.2-48	2 2
XBA399A	Cable, coaxial, flow cell volume		
XBA403A	Shield, flow cell tubing ground	8.2-39	2
XCA166A	Chamber, isolator (long)	8.2-45	5
XCA167A	Chamber, isolator (small)		
XDA481B	Valve, liquid. 2-way, normally closed, w/o coil		
XDA483B	Valve, liquid, 3-way, w/o coil		
XDA591AS	Syringe, 5diff assembly	8.2-14 8.2-15	2 10
XDA592AS	Syringe, reagent assembly	8.2-12 8.2-13	3 9
XDA593AS	Syringe, sampling assembly	8.2-20	2
XDA594AS	Motor, assembly, for 5diff syringe	8.2-14	1
XDA595AS	Motor, assembly, for reagent syringe	8.2-12	1
XDA596AS	Motor, assembly, for sample syringe	8.2-20	1
XDA597BS	Syringe, waste - complete assembly	8.2-16 8.2-17	2 1
XDA598BS	Syringe, vacuum - complete assembly	8.2-8 8.2-9	2 1
XDA601AS	Flow cell, assembly	8.2-39	1
XDA602B	Bath, assembly, 3-baths and rinse chamber (includes long coax cable)	8.2-47	3
XDA605A	Reservoir, diluent, assembly	8.2-6 8.2-7	1 8
XDA610B	Bath, WBC/BASO (includes long coax cable)	8.2-47	1
XDA611CS	Valve, liquid, 11-valve assembly (1-11)	8.2-1	1
XDA612CS	Valve, liquid, 5-valve assembly (12-16)	8.2-2	1
XDA613CS	Valve, liquid, 2-valve assembly (17-18)	8.2-3 8.2-19	1 2
XDA614CS	Valve, liquid, 7-valve assembly (20-26)	8.2-4	1
XDA615CS	Valve, liquid, 5-valve assembly (27-31)	8.2-5 8.2-45	1 4
XDA616AS	Piston, 5diff syringe, 190 µL needle	8.2-15	9

Table 8.1-3 Nonreturn Parts *(Continued)*

Part Number	Description	Figure	Item
XDA617AS	Piston, sample syringe, 100 µL needle	8.2-21	6
XDA618AS	Guide, sample probe retainer	8.2-26	1
XDA619AS	Probe, sample	8.2-28	1
XDA621A	O-ring, with matched washer, count/waste syringe, package of 10	8.2-9 8.2-13 8.2-17	2 2 2
XDA622A	O-ring, with matched washer, for reagent syringe, package of 10		
XDA623AS	Panel, reagent/waste fittings assembly	8.2-49	14
XDA625AS	Heater, reagent coil assembly	8.2-45	1
XDA626AS	Cover, diluent reservoir	8.2-7	2
XDA657B	Bath assembly, including WBC/Baso bath (includes long coax cable)		
XEA018A	Pickup tube, diluent (needs stopper)		
XEA286AS	Kit, O-ring and washer	8.2-7	7
XEA293AS	Kit, screws. Table 8.1-7 lists the contents of this kit. **Note:** The Screws kit contains the most common screws used in the A^{C}•T 5diff analyzer, plus nuts and washers.		
XEA311AS	Kit, fittings. Table 8.1-6 lists the contents of this kit. **Note:** The Fitting kit contains the most common pneumatic and hydraulic parts used in the A^{C}•T 5diff analyzer.		
XEA484A	Kit, installation (comes with instrument).Table 8.1-8 lists the contents of this kit.		
XEA485AS	Kit, maintenance, 6 month. Table 8.1-10 lists the contents of this kit.		
XEA486AS	Kit, maintenance, 1 year. Table 8.1-11 lists the contents of this kit.		
XEA487AS	Fan, bath enclosure temperature control	8.2-43	2
XEA488AS	Cable, heating coil harness		
XEA581AS	Kit, maintenance, every two years. Table 8.1-12 lists the contents of this kit.		
XEA616AS	Tubing, with sleeve, for flow cell sample port 6		
XEA643AS	Kit, software PROMS, A^{C}•T 5diff v1.03		

Table 8.1-4 Peripherals, Accessories and Consumables

Part Number	Description
2016891	Ribbon, black print, for EPSON LX300
4237615	Operator’s Manual, A^{C}•T 5diff (English)
4237616	Service Manual, A^{C}•T 5diff (English only)
4237630	Operator’s Manual, A^{C}•T 5diff (French)
4237631	Operator’s Manual, A^{C}•T 5diff (Italian)
4237632	Operator’s Manual, A^{C}•T 5diff (German)

Table 8.1-4 Peripherals, Accessories and Consumables *(Continued)*

Part Number	Description
4237633	Operator's Manual, A^{C}•T 5diff (Spanish)
4237634	Operator's Manual, A^{C}•T 5diff (Chinese)
7547175	Calibrator, A^{C}•T 5diff Cal
7547176	Control, A^{C}•T 5diff
8547168	Reagent, A^{C}•T 5diff Hgb Lyse
8547169	Reagent, A^{C}•T 5diff Diluent
8547170	Reagent, A^{C}•T 5diff WBC Lyse
8547171	Reagent, A^{C}•T 5diff Fix
8547176	Reagent, A^{C}•T 5diff Rinse
CBE070AS	Printer Head, Epson LX300^{+}
FBH016A	Cover, dust
LAD002AS	Latex particles, RBC/PLT (used for all procedures)
LAM004A	Grease, silicone
XAA473A	Printer, Epson LX300+ 220 V
XAA476A	Printer, Epson LX300+ 110 V
XEA019A	Grease, silicone, for syringe assembly
XEA381AS	Grease, for mechanical assemblies
XEA587AS	Bar code reader option

Table 8.1-5 Tools

Part Number	Description
5415407	Set, Allen wrenches, balldriver, metric
5450517	Screwdriver, 2.5 mm hex, balldriver
5450518	Screwdriver, 3.0 mm hex, balldriver
5450519	Bit, 2.5 mm hex balldriver, for 1/4 inch drive
5450520	Bit, 3.0 mm hex balldriver, for 1/4 inch drive
5450521	Screwdriver, torque, preset to 100 mN-m (14.2 oz.f-in), 1/4 inch drive
5450522	Screwdriver, torque, preset to 400 mN-m (56.8 oz.f-in), 1/4 inch drive
5450532	Screwdriver, T10 Torx
5450533	Bit, T10 Torx, for 1/4 inch drive
5450535	Screwdriver, small, Phillips 00
5450536	Magnifier, jeweller's loupe, 5X with 2 in. focal length
5450537	Extractor, chip remover, for U42 and U43
5450540	Gauge, feeler adjustment, 9.4 mm and 3.0 mm

Table 8.1-5 Tools *(Continued)*

Part Number	Description
6915456	Kit, 100 mN-m torque driver with 3 bits. Table 8.1-13 lists the contents of this kit.
6915457	Kit, 400 mN-m torque driver with 3 bits. Table 8.1-14 lists the contents of this kit.
6915458	Kit, assorted tools for A^{C}•T 5diff. Table 8.1-15 lists the contents of this kit.
MAB002A	Allen wrench, L-shape, 2.5 mm
MAB018A	Allen wrench, L-shape, 3.0 mm
MAB090A	Torx key, L-shape, T10
XDA555AS	Knob, used to adjust flowcell
XEA585AS	Torque screwdriver, A300, adjustable torque, 100 mN-m, 1/8 inch drive
XEA587AS	Torque screwdriver, A301, adjustable torque, 400 mN-m, 1/4 inch drive

Table 8.1-6 Fitting Kit Parts PN - XEA311AS

Part Number	Description	Quantity
EAA005A	Fitting, straight connector, 01.6 mm 1/8	10
EAA006A	Fitting, straight connector	10
EAA009A	Fitting, bent connector, i.d.1.5 10/32	10
EAA013A	Fitting, bent connector, 1/8	10
EAA014A	Fitting, straight connector, 1/8	10
EAB002A	Fitting, L-shaped connector	10
EAB003A	Fitting, connector04 mm H19.5	20
EAB005A	Fitting, T-connector, 01.6 mm T10-6	30
EAB006A	Fitting, T-connector, 02.3 mm	30
EAB009A	Fitting, straight connector, 01.6 mm	30
EAB010A	Fitting, straight connector, 02.3 mm	30
EAB014A	Fitting, straight connector, Y, 01.5 mm/1.5 mm	10
EAB021A	Fitting, Y-connector, 03 mm	3
EAB026A	Fitting, Y-connector, 02.5 mm	3
EAB035A	Fitting, T-connector, 02.3 mm T220-6	10

Table 8.1-7 Screws Kit Parts PN - XEA293AS

Part Number	Description	Quantity
KAA002A	Screw, hex M3x6	20
KAA003A	Screw, hex M3x8	20
KAA005A	Screw, hex M3x12	20

Table 8.1-7 Screws Kit Parts PN - XEA293AS *(Continued)*

Part Number	Description	Quantity
KAA006A	Screw, hex M3x14	20
KAA009A	Screw, hex M3x20	20
KAA011A	Screw, hex M3x30	20
KAA015A	Screw, hex M4x8	20
KAA016A	Screw, hex M4x12	20
KAA017A	Screw, hex M4x16	20
KAA021A	Screw, hex M5x10	20
KAA028A	Screw, hex M4x20	20
KAB002A	Screw, FHC M3x6	20
KAB003A	Screw, FHC M3x8	5
KAB004A	Screw, FHC M3x10	20
KAB005A	Screw, FHC M3x12	20
KAB016A	Screw, torx M3x8	5
KAC002A	Screw, TC M3x5	20
KAE003A	Screw, BHC M4x12 screw	20
KAH001A	Nut, HU M3	20
KAH002A	Nut, HU M4	20
KAH003A	Nut, HU M5	20
KAH024A	Nut, 1/4-28 (US std)	10
KAJ001A	Washer, M diameter 0.3	20
KAJ002A	Washer, M diameter 0.4	20
KAJ003A	Washer, M diameter 0.5	20
KAJ007A	Washer, AZ diameter 0.3	20
KAJ008A	Washer, Z diameter 0.4	20
KAJ009A	Washer, AZ diameter 0.5	20
KAJ010A	Washer, W grower diameter 0.5	20
KAM002A	Collar, plastic, M3x6 Lg.8	10
KAM003A	Collar, plastic, M4x6 Lg.8	10
KAM004A	Collar, plastic, M3.5x6 Lg.6	10
KAM005A	Collar, plastic, M3.5x6 Lg.8	10
KAM006A	Collar, plastic, M3.5x6 Lg.12	10
KAM010A	Collar, plastic, M3x6 Lg.10	10
KAM011A	Collar, plastic, M3.5x6 Lg.5.7	10
KAM013A	Collar, plastic, M3.5x6 Lg.10	10
KAM017A	Collar, brass, M3.5x6 Lg.3	10

Table 8.1-8 Installation Kit, PN - XEA484AS

Part Number	Description	Quantity
DAJ007A	Lamp, 20 W, 9.5 Vdc	1
DBH001A	Tie wrap LA=2.4 L=92	3
DBH002A	Tie wrap LA=3.6 L=140	3
DBK003A	Adhesive holder 3 mm	1
EAE007A	Tygon tube 1.52 mm (0.060 inch)	2
EAE006A	Tygon tube 1.295 mm (0.051 inch)	2
EAE034A	Tygon tube 2.54 mm (0.100 inch)	2
EAE005A	Tygon tube 1.02 mm (0.040 inch)	2
EAE008A	Tygon tube 2.05 mm (0.081 inch)	2
EAE011A	Cristal tube 3 mm (i.d.) x 6 mm (o.d.)	4
EAE028A	Cristal tube 4 mm (i.d.) x 6 mm (o.d.)	4
EAC019A	Luer male connector, i.d. 3 mm	3
EAC010A	Luer bushing, i.d. 3 mm	2
EAB021A	Fitting, Y-connector 3 mm	1
EAB033A	Fitting, T-connector (small)	1
EAB035A	Fitting, T-connector 2.3 mm T220-6 inches	1
FAA053A	O-ring, 1.40 x 1.25, fluocarbon	1
FBH016A	Instrument cover	1
FBL001A	Rubber cap 2 holes	1
GBG138A	Tool, right access panel fasteners	1
GBG156A	EPO counting head Joint	2
GBG144A	Reagent straw cap 027	3
GBG145A	Reagent straw cap 020	1
GAK302A	Factory bottle cap	3
GBG155A	Cap 025	1
MAB018A	Bent allen key 3 mm	1
MAB002A	Bent allen key 2.5 mm	1
MAB090A	Bent Torx key T10	1
XDA619AS	Equipped probe	1
XDA483B	Valve 3V (no solenoid)	1
XDA621A	O-ring 30.80 x 3.80 + wedge	1
XEA018A	Diluent pickup tube, 360 mm length	1
XEA019A	Grease KM 1011	1

Table 8.1-9 Waste Alarm Kit, PN - 6912680

Part Number	Description	Quantity
6706397	Alarm, waste, with 9V battery	1
6856742	Sensor, float	1

Table 8.1-10 6 Month Maintenance Kit, PN - XEA485AS

Part Number	Description	Quantity
FAA053A	O-ring, fluorocarbon, rinse block assembly	1
FAA065A	O-ring, silicone, Hgb Lyse reagent syringe	1
XDA621A	O-ring and washer, matched set, waste or count syringe	2
XDA622A	O-ring and washer, matched set, for all reagent syringes (except Hgb Lyse syringe)	4
XEA019A	Silicone grease	1

Table 8.1-11 1 Year Maintenance Kit, PN - XEA486AS

Part Number	Description	Quantity
DAJ007A	Lamp, optical bench, 20 W, 9.5 Vdc	1
FAA040A	O-ring, silicone, 5diff syringe	1
FAA046A	O-ring, coaxial cable, counting head	2
FAA064A	O-ring, fluorocarbon, sample syringe	2
FAA066A	O-ring, silicon, draining bath	4
FAA067A	O-ring, fluorocarbon, 5diff syringe	4
GBG156A	O-ring, aperture, counting head	4
XBA399A	Cable, coaxial, DIFF flow cell	1
XEA286AS	O-ring and washer, matched set, diluent reservoir	1

Table 8.1-12 Every 2 Years Maintenance Kit, PN - XEA581AS

Part Number	Description	Quantity
GBC031A	Piston, Hgb Lyse reagent syringe	1
GBC030A	Pistons, reagent syringes assembly	4
GBG052A	Piston, waste or count syringe	2
GBG091A	Block, sample probe guide	1
XDA619AS	Probe, sample	1

Table 8.1-13 100 mN-m Torque Driver Kit, - PN 6915456

Part Number	Description	Quantity
5450519	Bit, 2.5 mm hex balldriver, for 1/4 inch drive	1
5450520	Bit, 3.0 mm hex balldriver, for 1/4 inch drive	1
5450521	Screwdriver, torque, preset to 100 mN-m (14.2 oz.f-in), 1/4 inch drive	1
5450533	Bit, T10 Torx, for 1/4 inch drive	1

Table 8.1-14 400 mN-m Torque Driver Kit, - PN 6915457

Part Number	Description	Quantity
5450519	Bit, 2.5 mm hex balldriver, for 1/4 inch drive	1
5450520	Bit, 3.0 mm hex balldriver, for 1/4 inch drive	1
5450522	Screwdriver, torque, preset to 400 mN-m (56.8 oz.f-in), 1/4 inch drive	1
5450533	Bit, T10 Torx, for 1/4 inch drive	1

Table 8.1-15 Assorted Tools Kit, - PN 6915458

Part Number	Description	Quantity
5415407	Set, Allen wrenches, balldriver, metric	1
5450517	Screwdriver, 2.5 mm hex, balldriver	1
5450518	Screwdriver, 3.0 mm hex, balldriver	1
5450532	Screwdriver, T10 Torx	1
5450535	Screwdriver, small, Phillips 00	1
5450536	Magnifier, jeweller’s loupe, 5X with 2 in. focal length	1
5450537	Extractor, chip remover, for U42 and U43	1

8.2 ILLUSTRATED PARTS

The exploded views in this section are shown for informational purposes only. Many of the subcomponents are not available. Consult the MASTER PARTS LISTS for part availability.

Figure 8.2-1 11-Valves Assembly (See Table 8.2-1)

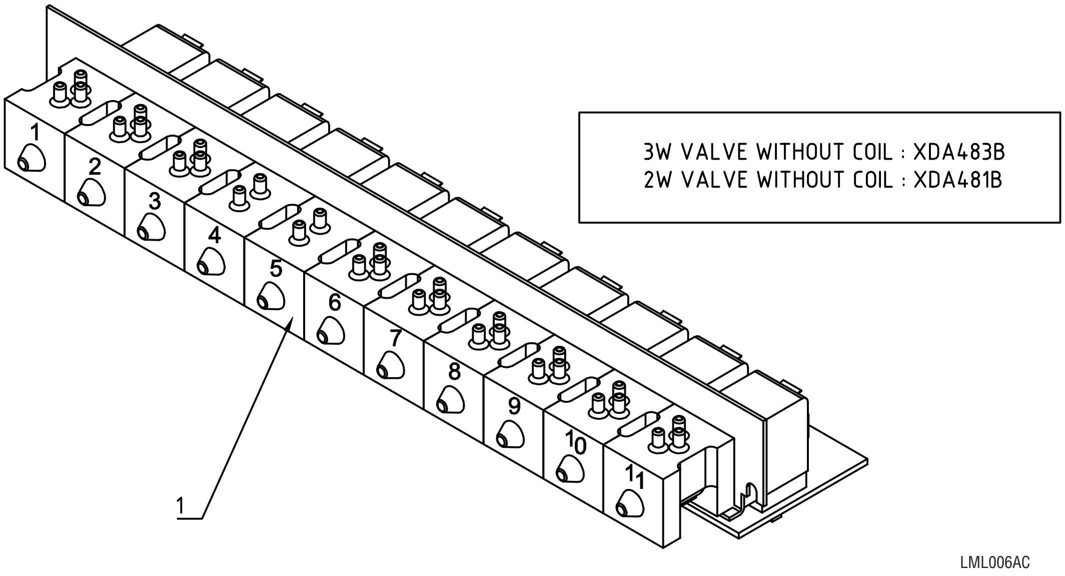
1
2
3
4
5
6
7
8
9
10
11
1
3W VALVE WITHOUT COIL : XDA483B
2W VALVE WITHOUT COIL : XDA481B
LML006AC

Table 8.2-1 11-Valves Assembly (See Figure 8.2-1)

Item	Part Number	Description
1	XDA611CS	Valve, liquid, 11-valve assembly (1-11)

Figure 8.2-2 5-Valves Assembly (See Table 8.2-2)

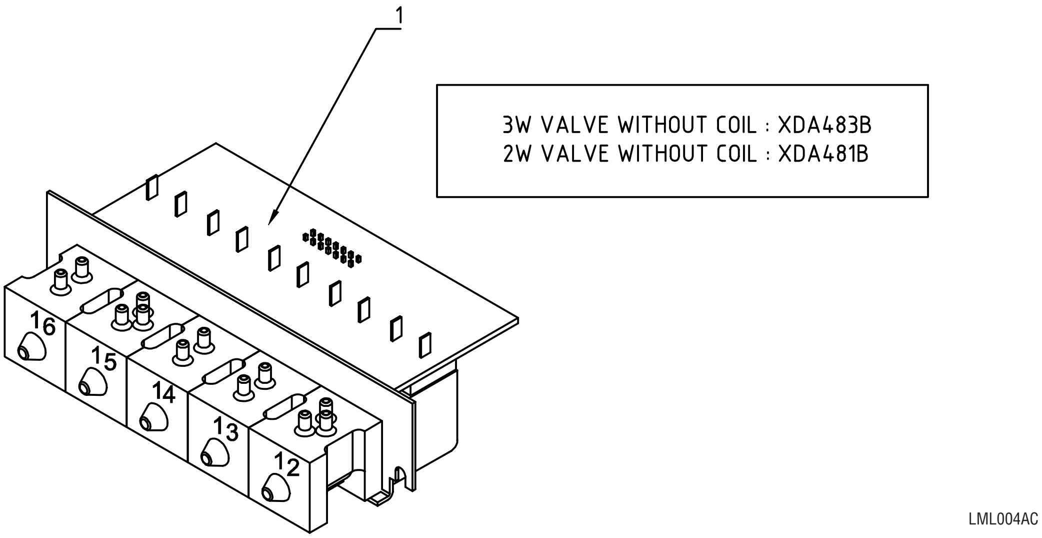
1
3W VALVE WITHOUT COIL : XDA483B
2W VALVE WITHOUT COIL : XDA481B
16
15
14
13
12
LML004AC

Table 8.2-2 5-Valves Assembly (See Figure 8.2-2)

Item	Part Number	Description
1	XDA612CS	Valve, liquid, 5-valve assembly (12-16)

Figure 8.2-3 2-Valves Assembly (See Table 8.2-3)

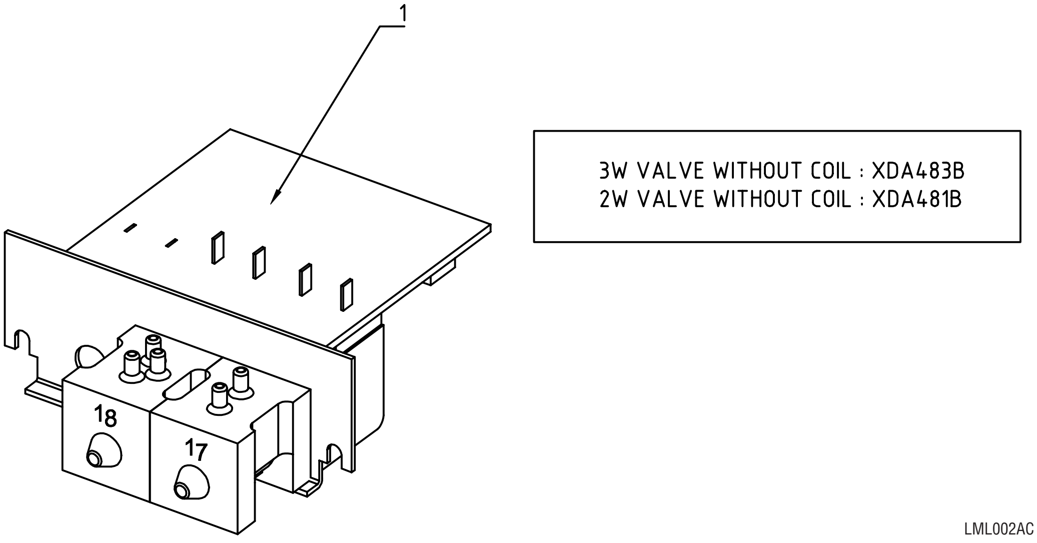
1
3W VALVE WITHOUT COIL : XDA483B
2W VALVE WITHOUT COIL : XDA481B
18
17
LML002AC

Table 8.2-3 2-Valves Assembly (See Figure 8.2-3)

Item	Part Number	Description
1	XDA613CS	Valve, liquid, 2-valve assembly (17-18)

Figure 8.2-4 7-Valves Assembly (See Table 8.2-4)

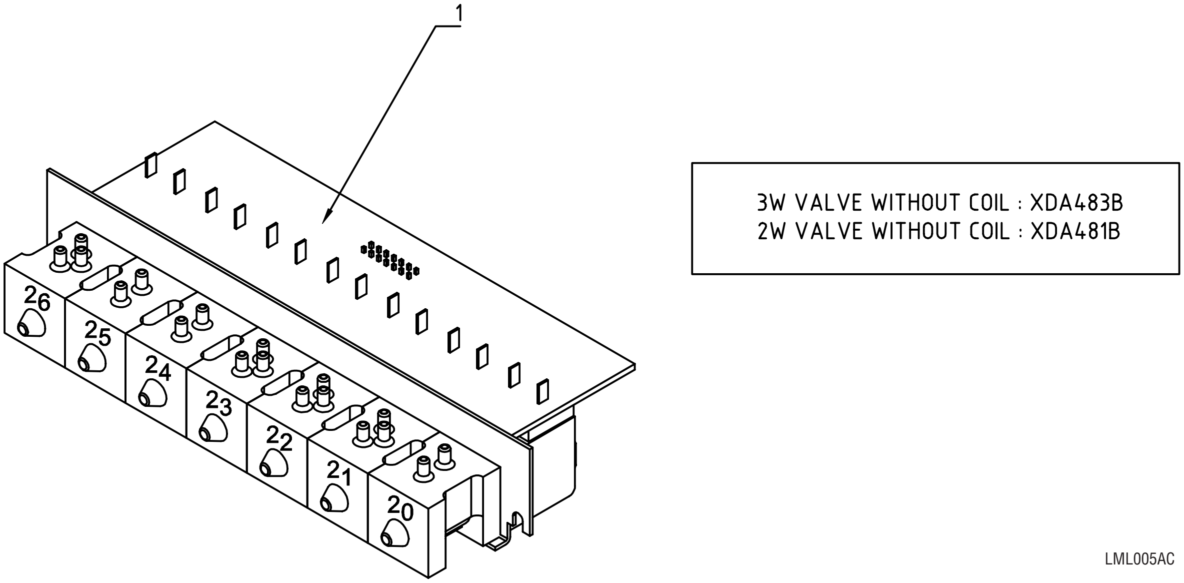
1
26
25
24
23
22
21
20
3W VALVE WITHOUT COIL : XDA483B
2W VALVE WITHOUT COIL : XDA481B
LML005AC

Table 8.2-4 7-Valves Assembly (See Figure 8.2-4)

Item	Part Number	Description
1	XDA614CS	Valve, liquid, 7-valve assembly (20-26)

Figure 8.2-5 5-Valves Assembly (See Table 8.2-5)

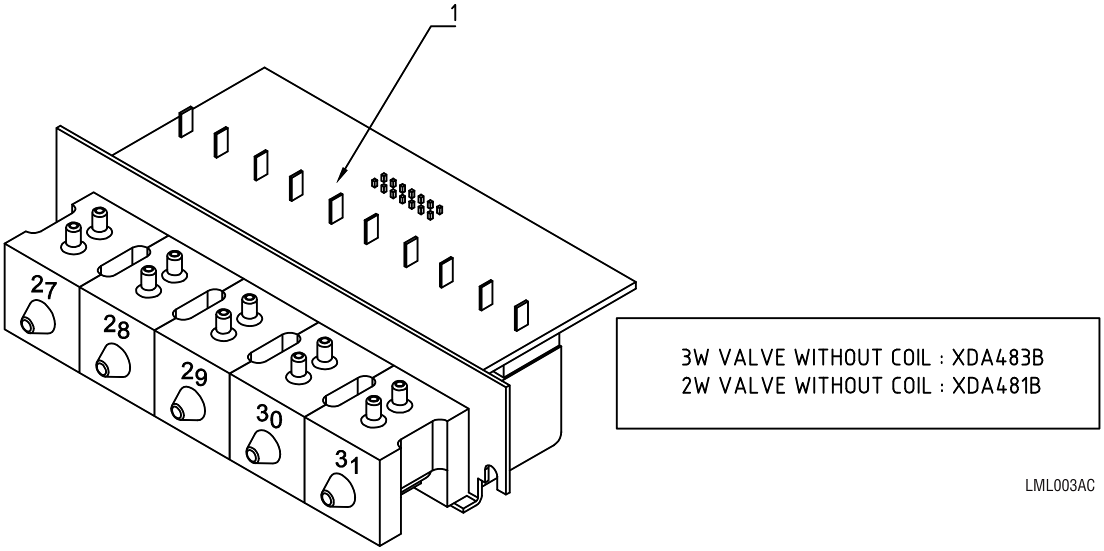
1
27
28
29
30
31
3W VALVE WITHOUT COIL : XDA483B
2W VALVE WITHOUT COIL : XDA481B
LML003AC

Table 8.2-5 5-Valves Assembly (See Figure 8.2-5)

Item	Part Number	Description
1	XDA615CS	Valve, liquid, 5-valve assembly (27-31)

Figure 8.2-6 Right Side Compartment, Lower Rear Area (See Table 8.2-6)

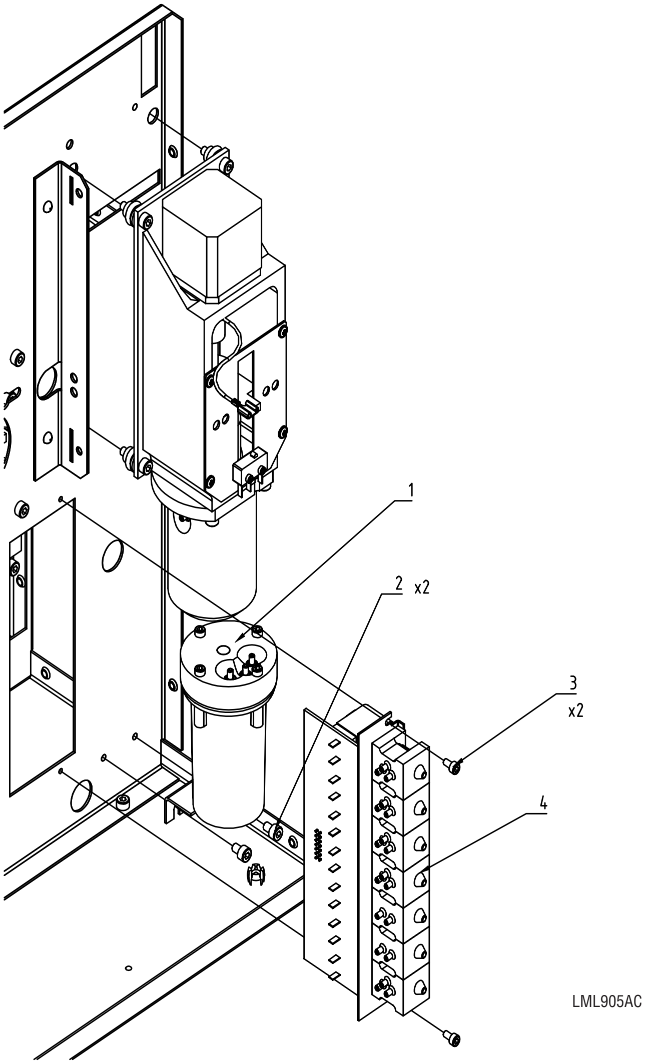

Table 8.2-6 Right Side Compartment, Lower Rear Area (See Figure 8.2-6)

Item	Part Number	Description
1	XDA605A	Reservoir, diluent, assembly
2	KAA013A	Screw, hex M4x6
3	KAA002A	Screw, hex M3x6
4	XDA603CS	Valve, liquid, 7-valve assembly (20-26)

Figure 8.2-7 Diluent Reservoir Assembly (See Table 8.2-7)

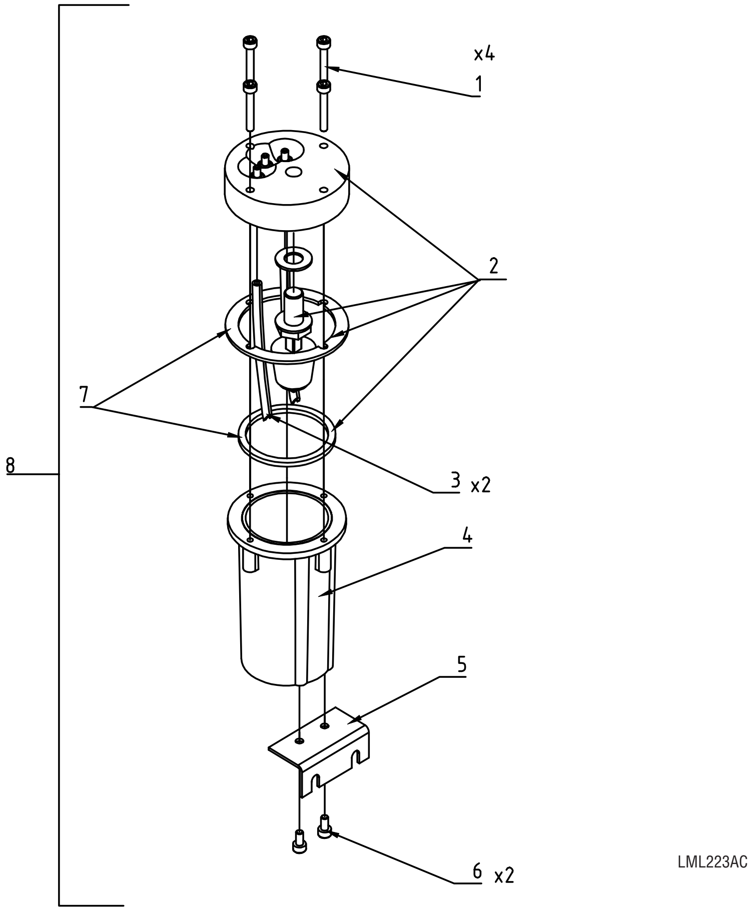

Table 8.2-7 Diluent Reservoir Assembly (See Figure 8.2-7)

Item	Part Number	Description
1	KAA009A	Screw, hex M3x20
2	XDA626AS	Cover, diluent reservoir
3	EAE008A	Tubing, Tygon, 2.05 mm i.d. (0.081 in.), 2 meter length
4	GAL094A	Chamber, diluent reservoir
5	GBG056A	Brace, reservoir, diluent
6	KAA002A	Screw, hex M3x6
7	XEA286AS	Kit, O-ring and washer
8	XDA605A	Reservoir, diluent, assembly

Figure 8.2-8 Count Syringe and Motor Assembly (See Table 8.2-8)

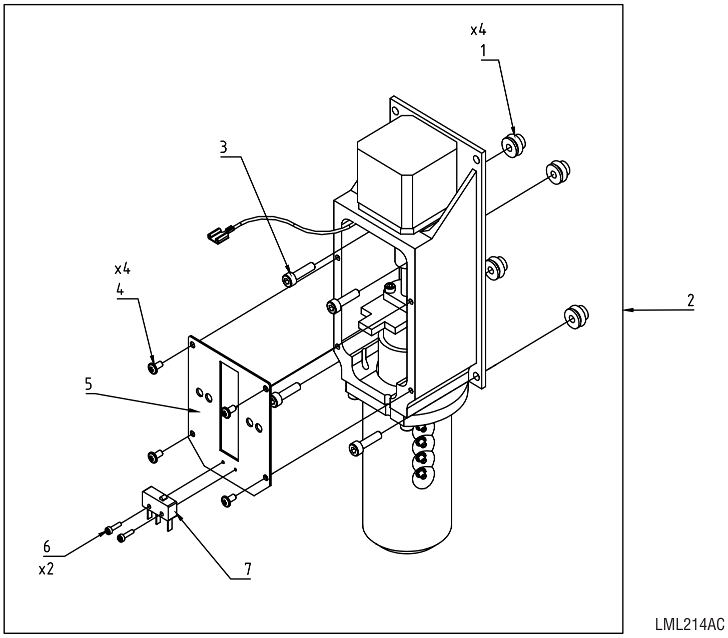

Table 8.2-8 Count Syringe and Motor Assembly (See Figure 8.2-8)

Item	Part Number	Description
1	FAL009A	Nut, shock mount, package of 12 - for most subassemblies
2	XDA598AS XDA598BS	Syringe, vacuum - complete assembly Syringe, vacuum - complete assembly (includes anti-extrusion ring)
3	KAA017A	Screw, hex M4x16
4	KZZ022A	Screw, auto-threaded
5	GBG027A	Plate, microswitch, motor
6	KAA040A	Screw, hex M2x8
7	CAE010A	Switch, microswitch XC5-81

Figure 8.2-9 Count Syringe Assembly (See Table 8.2-9)

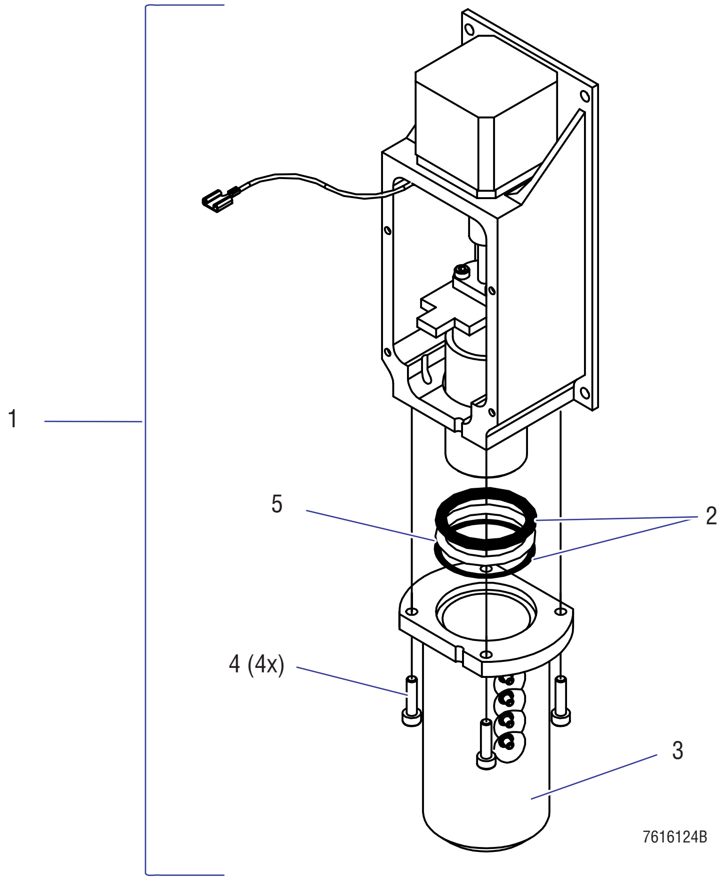

Table 8.2-9 Count Syringe Assembly (See Figure 8.2-9)

Item	Part Number	Description
1	XDA598AS	Syringe, vacuum - complete assembly
	XDA598BS	Syringe, vacuum - complete assembly (includes anti-extrusion ring)
2	XDA621A	O-ring, with matched washer, count/waste syringe, package of 10
3	GBG053A	Syringe, count, body
4	KA017A	Screw, hex M4x16
5	GBG219A	Anti-extrusion ring

Figure 8.2-10 Count Syringe Motor Assembly (See Table 8.2-10)

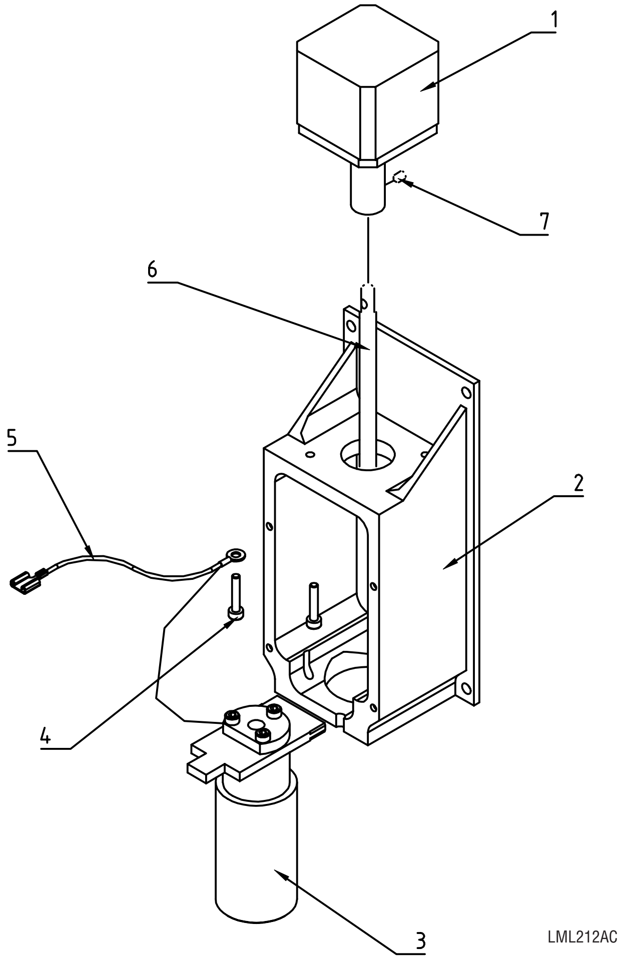

Table 8.2-10 Count Syringe Motor Assembly (See Figure 8.2-10)

Item	Part Number	Description
1	XBA390A	Motor, for syringe assembly
2	GBG050A	Body, count syringe
3		Piston assembly, count syringe (See Figure 8.2-11)
4	KAA007A	Screw, hex M3x16
5		Grounding wire
6	GBG029A	Syringe screw
7	KAD016A	Screw, HC M4x6

Figure 8.2-11 Count Syringe Piston Assembly (See Table 8.2-11)

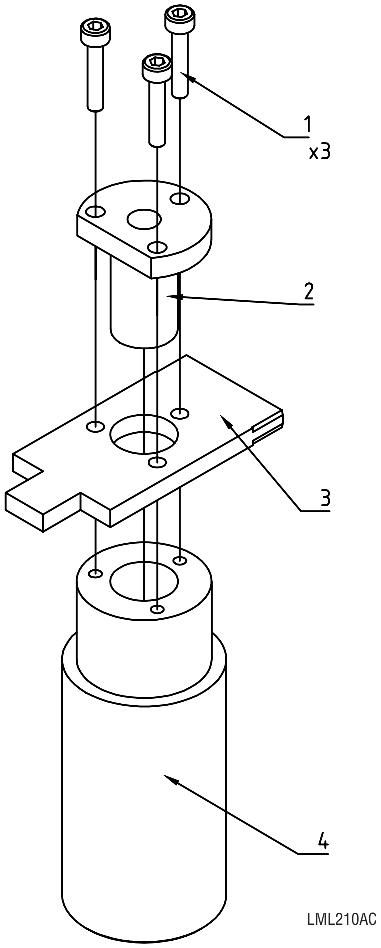

Table 8.2-11 Count Syringe Piston Assembly (See Figure 8.2-11)

Item	Part Number	Description
1	KAA007A	Screw, hex M3x16
2	GBG029A	Syringe nut
3	GBG051A	Guide plate, count/waste syringe
4	GBG052A	Piston, count/waste syringe

Figure 8.2-12 Reagent Syringes and Motor Assembly (See Table 8.2-12)

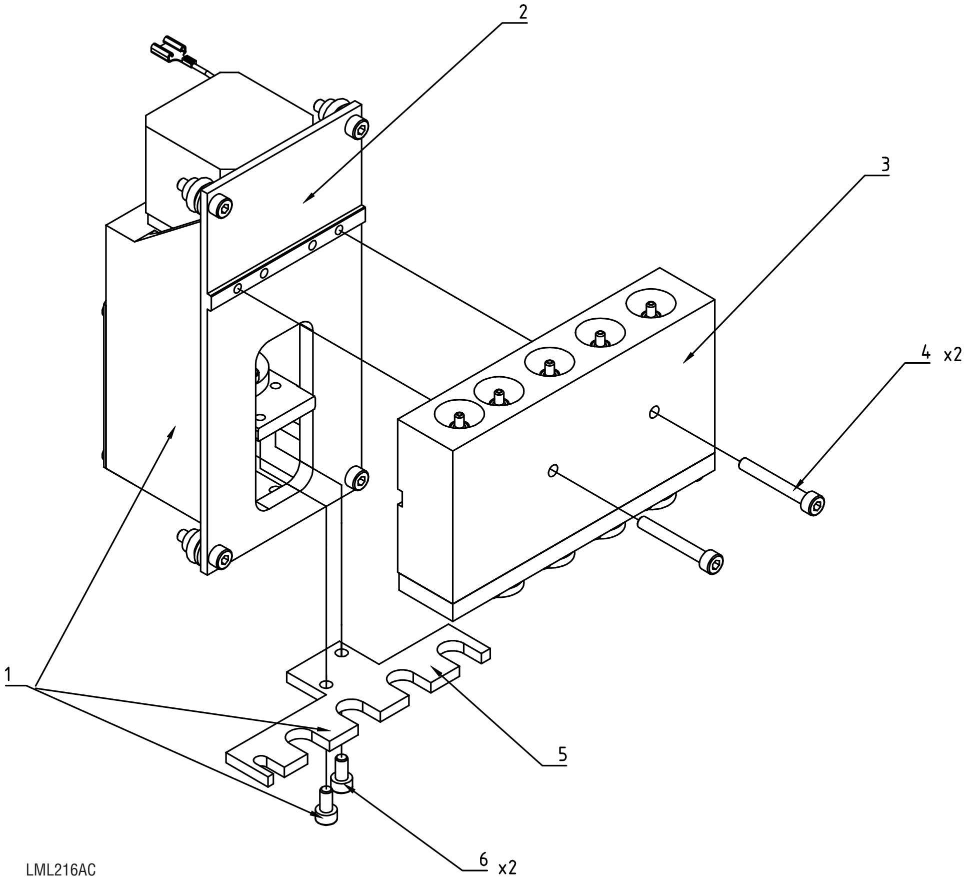

Table 8.2-12 Reagent Syringes and Motor Assembly (See Figure 8.2-12)

Item	Part Number	Description
1	XDA595AS	Motor, assembly - for reagent syringe
2		Motor - for reagent syringe
3	XDA592AS	Syringes, reagent assembly
4	KAA030A	Screw, hex M4x30
5	GBG035A	Guide plate, reagent syringe
6	KAA015A	Screw, hex M4x8

Figure 8.2-13 Reagent Syringes Assembly (See Table 8.2-13)

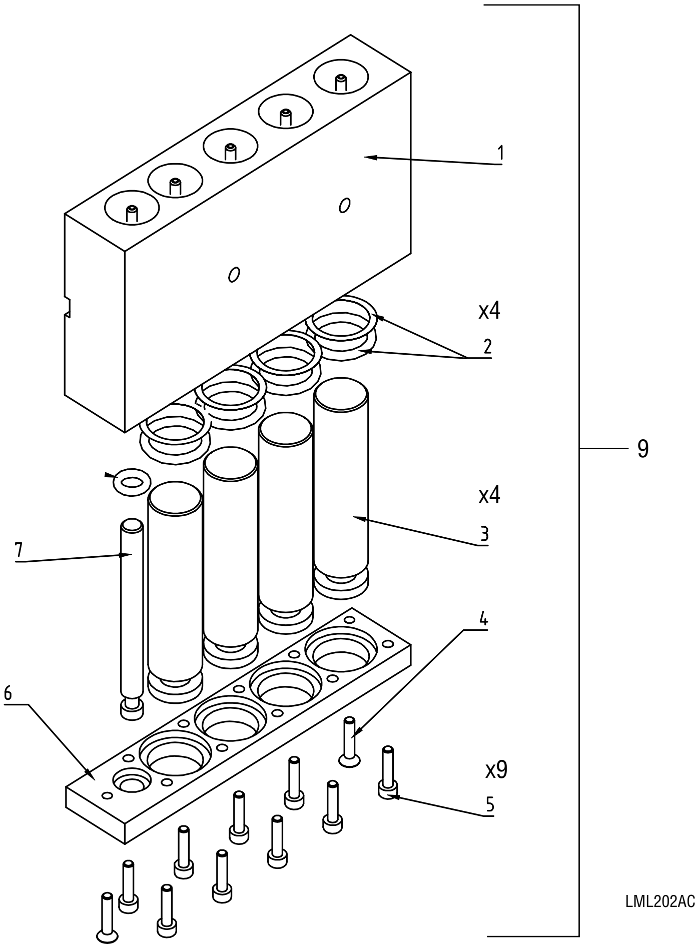

Table 8.2-13 Reagent Syringes Assembly (See Figure 8.2-13)

Item	Part Number	Description
1	GBG033A	Syringe, reagent, body
2	XDA621A	O-ring, with matched washer, count/waste syringe, package of 10
3	GBC030A	Piston, reagent syringe, large
4	KAB017A	Screw, torx M3x12
5	KAA005A	Screw, hex M3x12
6	GBG034A	Syringe, reagent, top
7	GBC031A	Piston, reagent syringe, lyse
8	FAA065A	O-ring, reagent syringe, 6.3 mm diameter, package of 10
9	XDA592AS	Syringe, reagent assembly

Figure 8.2-14 5diff Syringe and Motor Assembly (See Table 8.2-14)

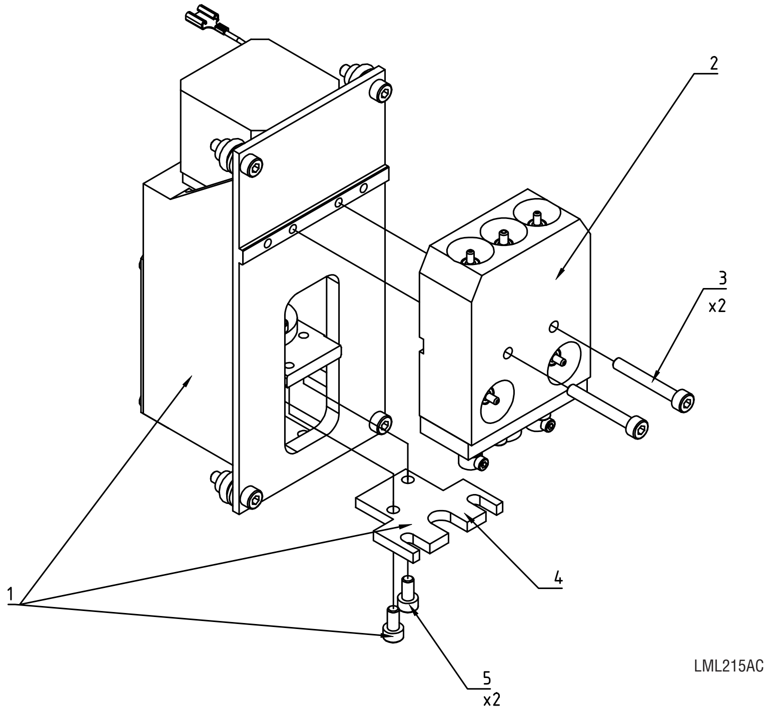

Table 8.2-14 5diff Syringe and Motor Assembly (See Figure 8.2-14)

Item	Part Number	Description
1	XDA594AS	Motor, assembly - for 5diff syringe
2	XDA591AS	Syringe, 5diff assembly
3	KAA030A	Screw, hex M4x30
4	GBG039A	Guide plate, syringe
5	KAA015A	Screw, hex M4x6

Figure 8.2-15 5diff Syringe Assembly (See Table 8.2-15)

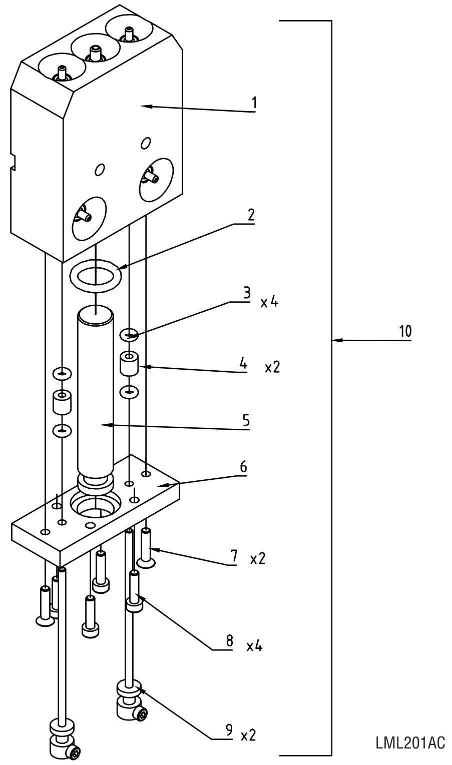

Table 8.2-15 5diff Syringe Assembly (See Figure 8.2-15)

Item	Part Number	Description
1	GBG037A	Syringe, 5diff, body
2	FAA040A	O-ring, 5diff syringe, 12.1 mm diameter, package of 10
3	FAA067A	O-ring, 5diff syringe, 2.4 mm diameter, package of 10
4	GBG042A	Syringe, 5diff, O-ring collar
5	GBG040A	Piston, 5diff syringe
6	GBG038A	Syringe top
7	KAB017A	Screw, torx M3x12
8	KAA005A	Screw, hex M3x12
9	XDA616AS	Piston, 5diff syringe, 190 µL needle
10	XDA591AS	Syringe, 5diff assembly

Figure 8.2-16 Waste Syringe and Motor Assembly (See Table 8.2-16)

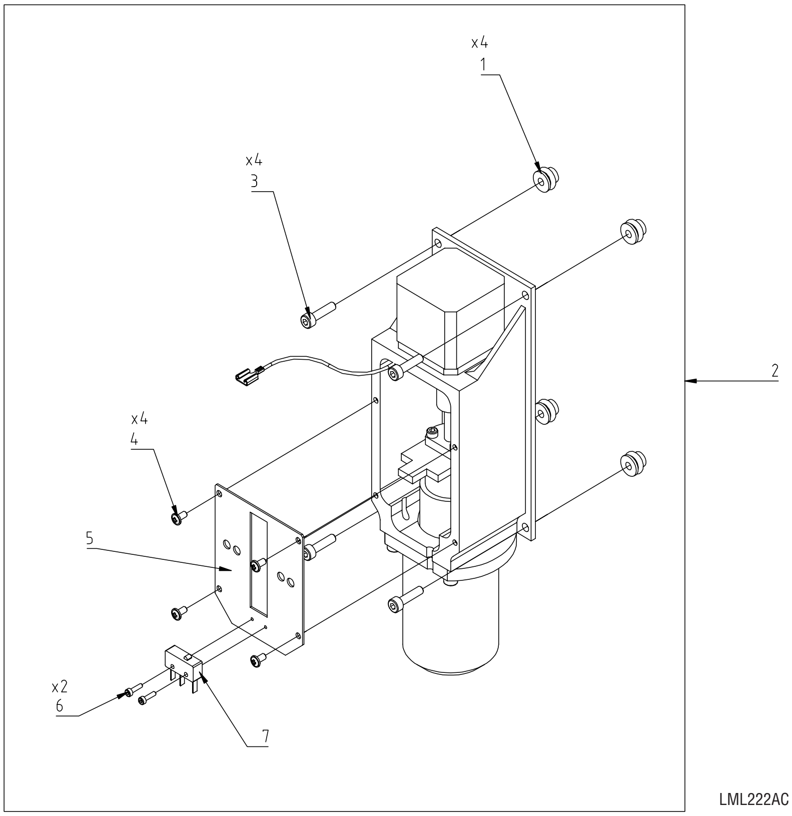

Table 8.2-16 Waste Syringe and Motor Assembly (See Figure 8.2-16)

Item	Part Number	Description
1	FAL009A	Nut, shock mount, package of 12 - for most subassemblies
2	XDA597AS	Syringe, waste - complete assembly
	XDA597BS	Syringe, waste - complete assembly (includes anti-extrusion ring)
3	KAA017A	Screw, hex M4x16
4	KZZ022A	Screw, auto-threaded
5	GBG027A	Plate, microswitch, motor
6	KAA040A	Screw, hex M2x8
7	CAE010A	Switch, microswitch XC5-81

Figure 8.2-17 Waste Syringe Assembly (See Table 8.2-17)

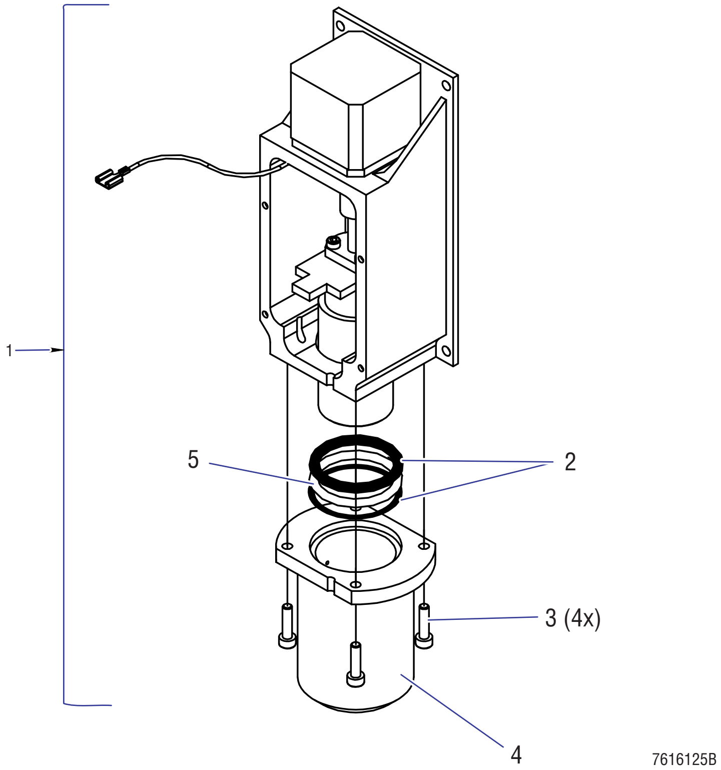

Table 8.2-17 Waste Syringe Assembly (See Figure 8.2-17)

Item	Part Number	Description
1	XDA597AS XDA597BS	Syringe, waste - complete assembly Syringe, waste - complete assembly (includes anti-extrusion ring)
2	XDA621A	O-ring, with matched washer, count/waste syringe, package of 10
3	KAA017A	Screw, hex M4x16
4	GBG054A	Syringe, waste, body
5	BGG219A	Anti-extrusion ring

Figure 8.2-18 Syringe Motor (See Table 8.2-18)

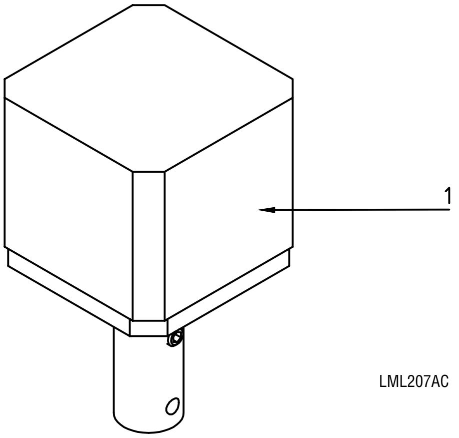

Table 8.2-18 Syringe Motor (See Figure 8.2-18)

Item	Part Number	Description
1	XBA390A	Motor - for syringe assembly

Figure 8.2-19 Sample Motor (See Table 8.2-19)

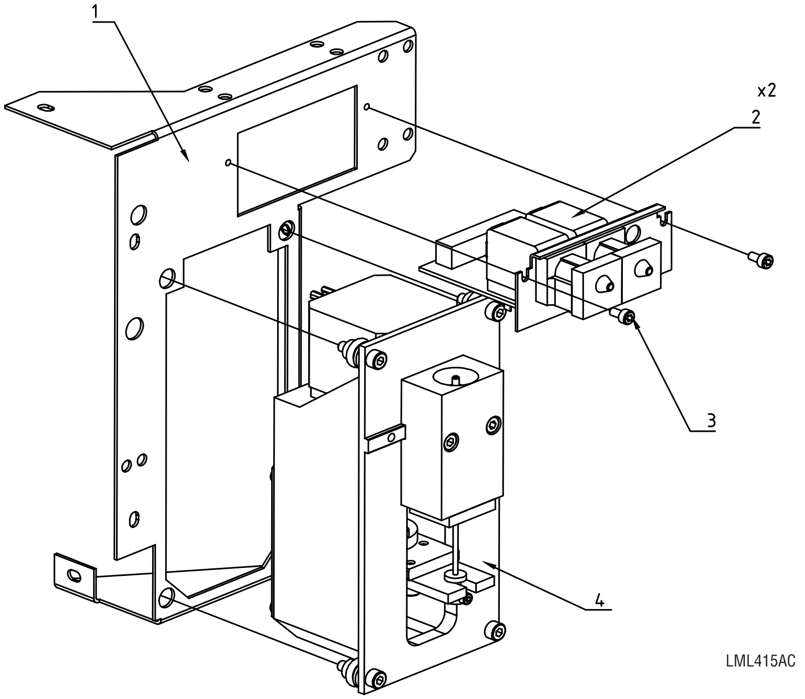

Table 8.2-19 Sample Motor (See Figure 8.2-19)

Item	Part Number	Description
1	GBG086A	Support plate, sample syringe
2	XDA613CS	Valve, liquid, 2-valve assembly (17-18)
3	KAA002A	Screw, hex M3x6
4		Sample Syringe and Motor Assembly (See Figure 8.2-20)

Figure 8.2-20 Sample Syringe and Motor Assembly (See Table 8.2-20)

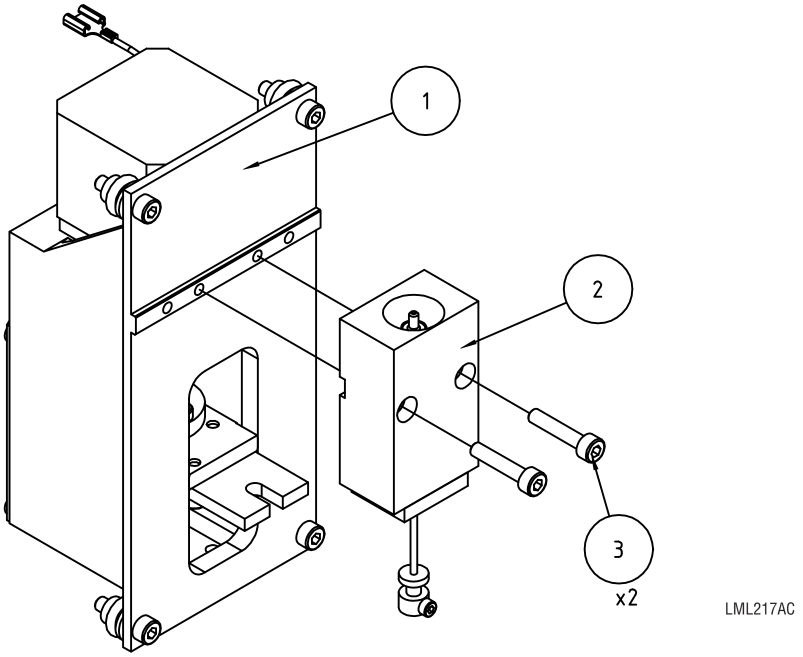

Table 8.2-20 Sample Syringe and Motor Assembly (See Figure 8.2-20)

Item	Part Number	Description
1	XDA596AS	Motor, assembly - for sample syringe (See Figure 8.2-22)
2	XDA593AS	Syringe, sampling assembly (See Figure 8.2-21)
3	KAA028A	Screw, hex M4x20

Figure 8.2-21 Sample Assembly Syringe (See Table 8.2-21)

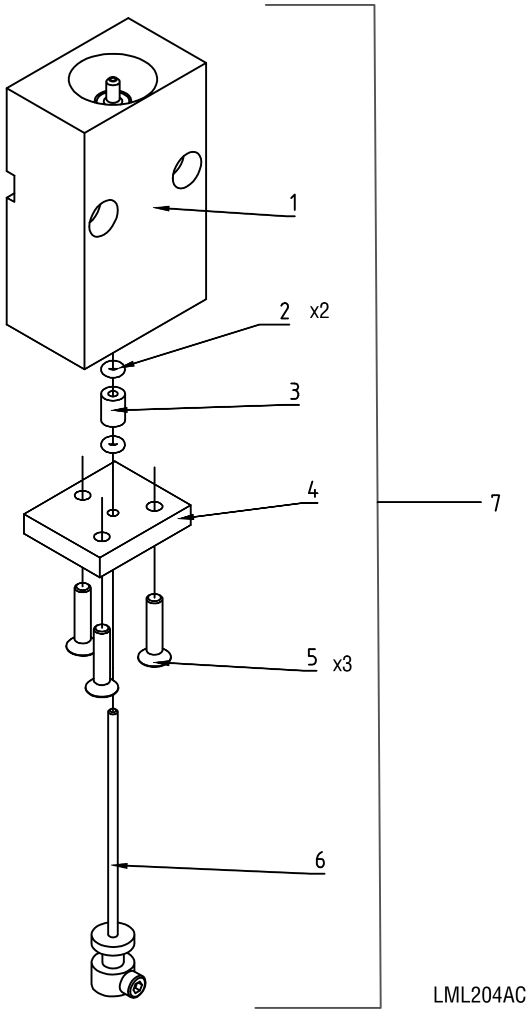

Table 8.2-21 Sample Assembly Syringe (See Figure 8.2-21)

Item	Part Number	Description
1	GBG044A	Syringe, sample, body
2	FAA064A	O-ring, sample syringe, package of 10
3	GBG048A	Syringe, sample, O-ring collar
4	GBG045A	Syringe top, sampling
5	KAB017A	Screw, torx M3x12
6	XDA617AS	Piston, sample syringe, 100 µL needle
7	XDA593AS	Syringe, sampling assembly

Figure 8.2-22 Sample Syringe Motor Assembly (See Table 8.2-22)

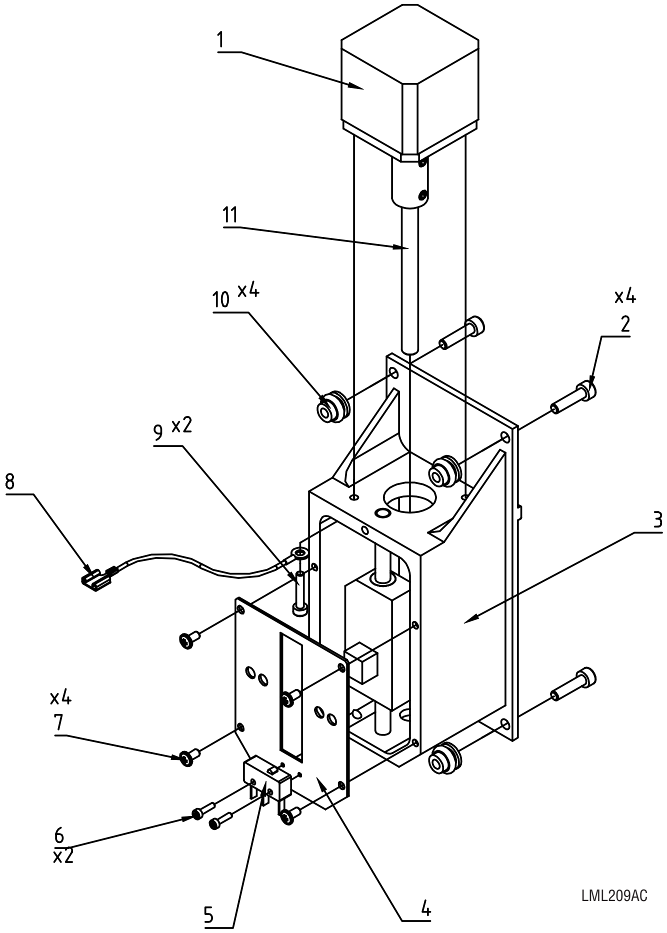

Table 8.2-22 Sample Syringe Motor Assembly (See Figure 8.2-22)

Item	Part Number	Description
1	XBA390A	Motor - for syringe assembly
2	KAA017A	Screw, hex M4x16
3		Syringe Motor Housing Assembly (See Figure 8.2-23)
4	GBG027A	Plate, microswitch, motor
5	CAE010A	Switch, microswitch XC5-81
6	KAA040A	Screw, hex M2x8
7	KZZ022A	Screw, auto-threaded
8		Grounding wire
9	KAA007A	Screw, hex M3x16
10	FAL009A	Nut, shock mount, package of 12 - for most subassemblies
11	GBG025A	Syringe screw

Figure 8.2-23 Syringe Motor Housing Assembly (See Table 8.2-23)

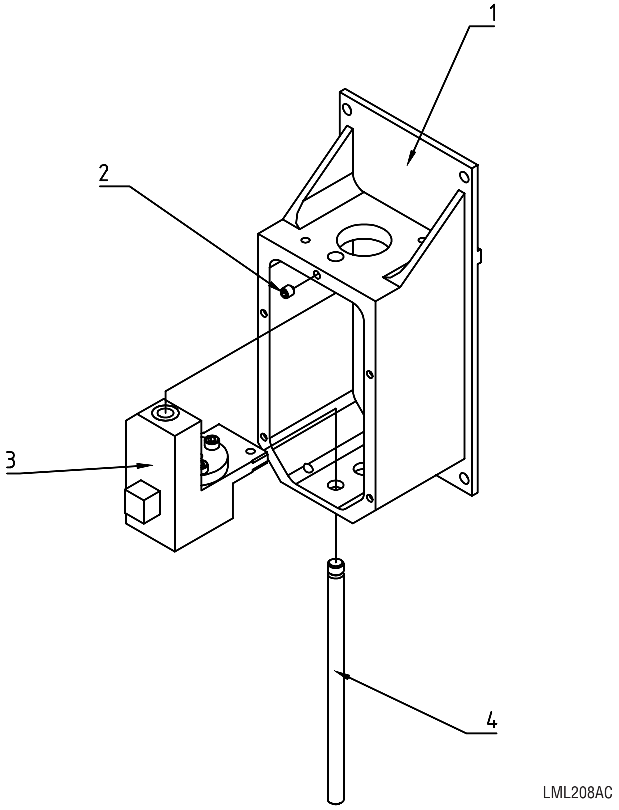

Table 8.2-23 Syringe Motor Housing Assembly (See Figure 8.2-23)

Item	Part Number	Description
1	GBG028A	Motor housing, syringe
2	KAD016A	Screw, HC M4x6
3		Syringe Motor Guide Block (See Figure 8.2-24)
4	GBG030A	Motor guide, assembly

Figure 8.2-24 Syringe Motor Guide Block Assembly (See Table 8.2-24)

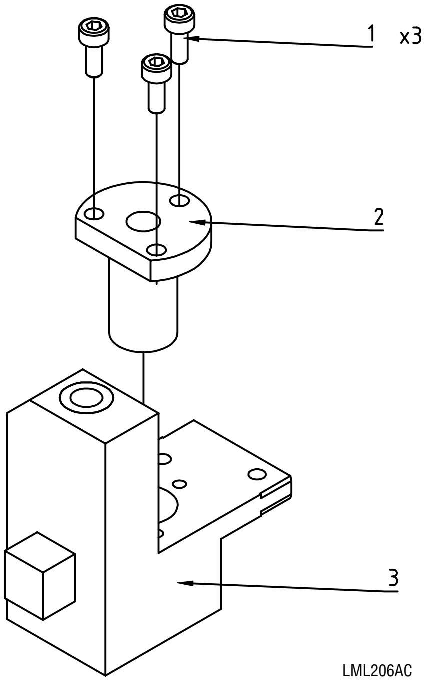

Table 8.2-24 Syringe Motor Guide Block Assembly (See Figure 8.2-24)

Item	Part Number	Description
1	KAA003A	Screw, hex M3x8
2	GBG029A	Syringe nut
3	GBG031A	Motor guide block, syringe

Figure 8.2-25 Sample Probe Retainer and Guide Assembly (See Table 8.2-25)

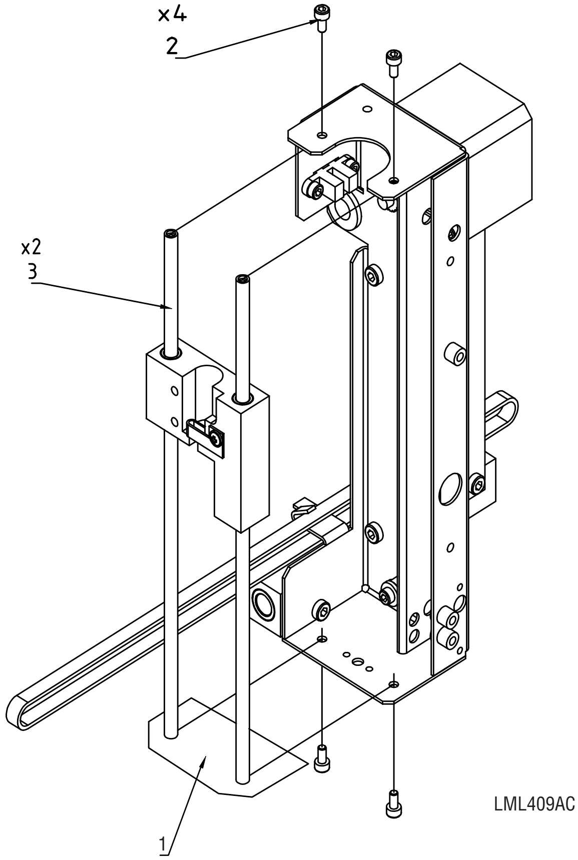

Table 8.2-25 Sample Probe Retainer and Guide Assembly (See Figure 8.2-25)

Item	Part Number	Description
1	GBG162A	Centering sheet, steel
2	KAA002A	Screw, hex M3x6
3	GBG081A	Needle axis

Figure 8.2-26 Sample Probe Retainer (See Table 8.2-26)

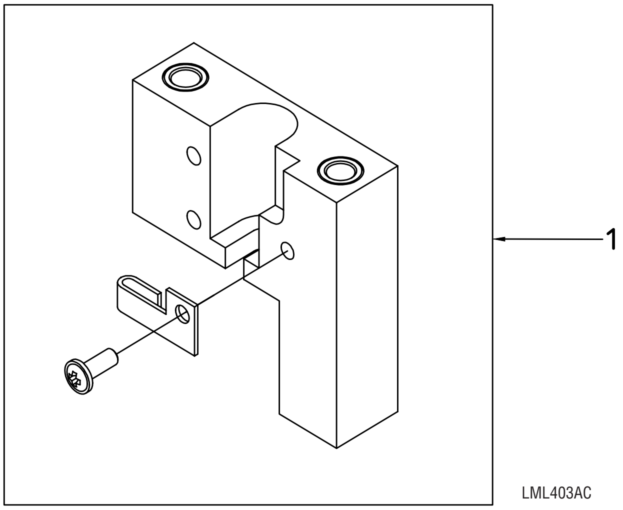

Table 8.2-26 Sample Probe Retainer (See Figure 8.2-26)

Item	Part Number	Description
1	XDA618AS	Guide, sample probe retainer

Figure 8.2-27 Rinse Block Assembly (See Table 8.2-27)

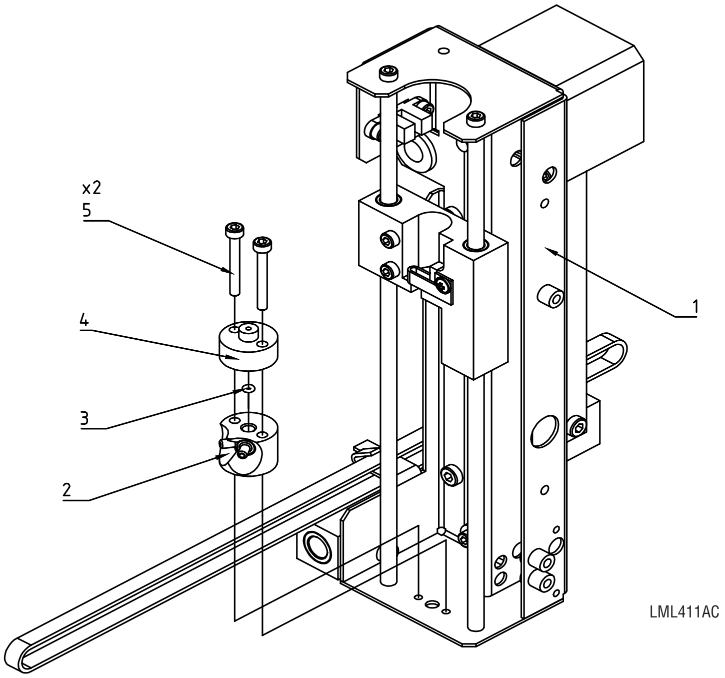

Table 8.2-27 Rinse Block Assembly (See Figure 8.2-27)

Item	Part Number	Description
1		Traverse vertical movement components - Home sensor (See Figure 8.2-33)
2	GBG090A	Sample probe, rinse block
3	FAA053A	O-ring, probe rinse block, package of 10
4	GBG091A	Sample probe, guide
5	KAA010A	Screw, hex M3x25

Figure 8.2-28 Sample Probe (See Table 8.2-28)

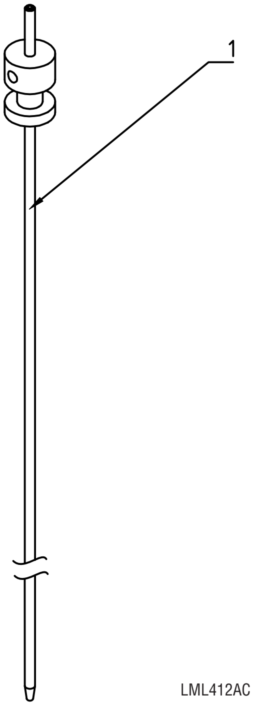

Table 8.2-28 Sample Probe (See Figure 8.2-28)

Item	Part Number	Description
1	XDA619AS	Probe, sample

Figure 8.2-29 Traverse Vertical Movement Components - Belt Retainer (See Table 8.2-29)

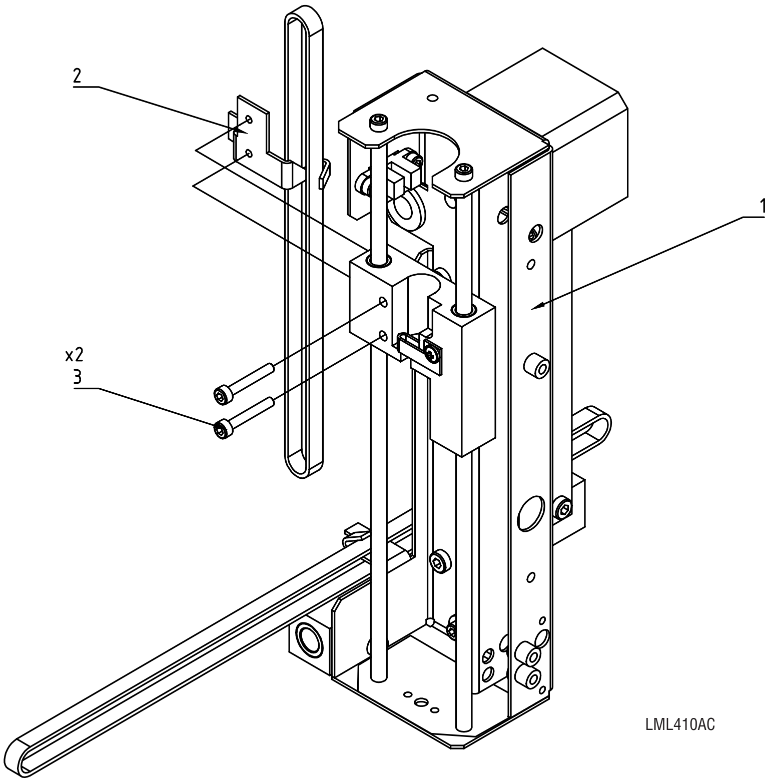

Table 8.2-29 Traverse Vertical Movement Components - Belt Retainer (See Figure 8.2-29)

Item	Part Number	Description
1		Traverse vertical movement components - Home sensor (See Figure 8.2-33)
2		Belt, probe vertical, assembly, 364 tooth
3	KAA009A	Screw, hex M3x20

Figure 8.2-30 Vertical Traverse Vertical Movement Components - Belt (See Table 8.2-30)

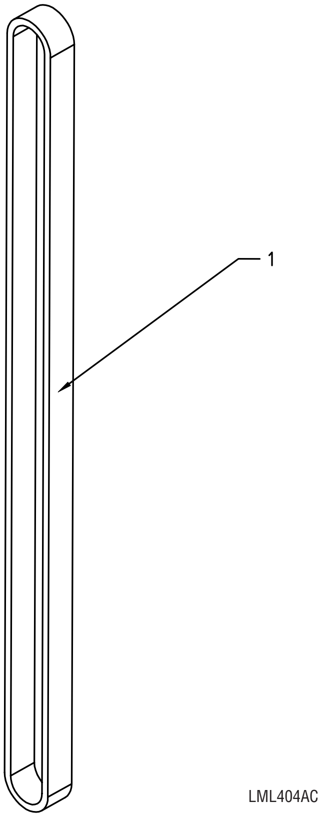

Table 8.2-30 Vertical Traverse Vertical Movement Components - Belt (See Figure 8.2-30)

Item	Part Number	Description
1	FBR011A	Belt, probe vertical, 364 tooth

Figure 8.2-31 Traverse Vertical Movement Components - Motor and Pulley (See Table 8.2-31)

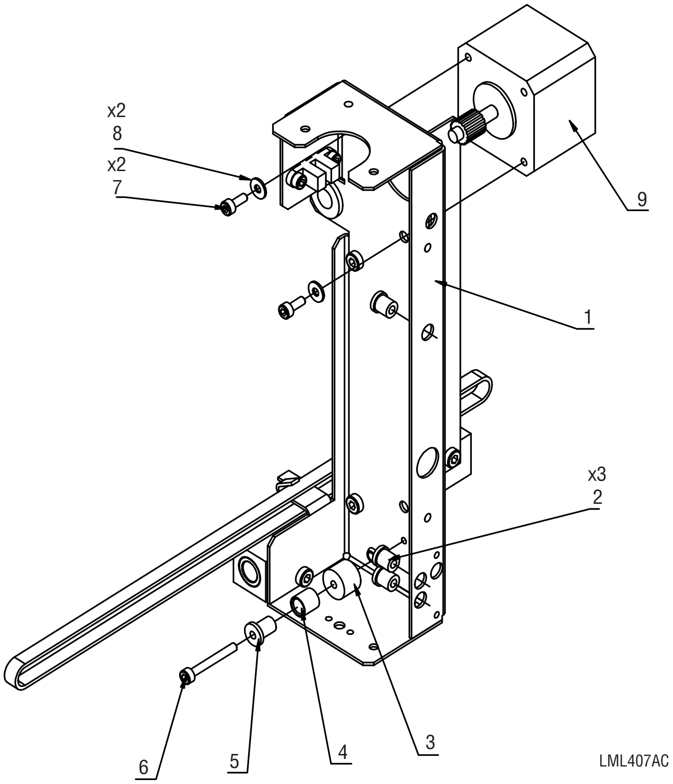

Table 8.2-31 Traverse Vertical Movement Components - Motor and Pulley (See Figure 8.2-31)

Item	Part Number	Description
1		Traverse vertical movement components - Home sensor (See Figure 8.2-33)
2	DBE014A	Wire guide
3	GBC147A	Pulley holder
4	GBG093A	Pulley, belt freewheel
5	FAG011A	Bearing
6	KAA010A	Screw, hex M3x25
7	KAA002A	Screw, hex M3x6
8	KAJ001A	Washer, M diameter 0.3
9	XBA392A	Motor, sample probe, vertical

Figure 8.2-32 Traverse Vertical Movement Components - Motor (See Table 8.2-32)

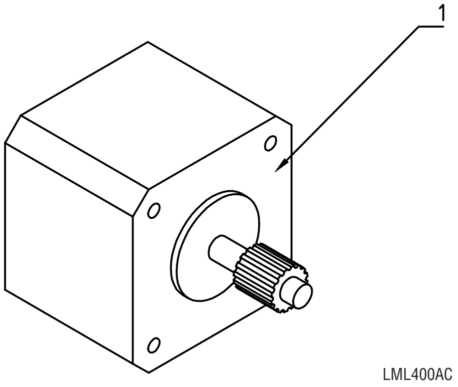

Table 8.2-32 Traverse Vertical Movement Components - Motor (See Figure 8.2-32)

Item	Part Number	Description
1	XBA392A	Motor, sample probe, vertical

Figure 8.2-33 Traverse Vertical Movement Components - Home Sensor (See Table 8.2-33)

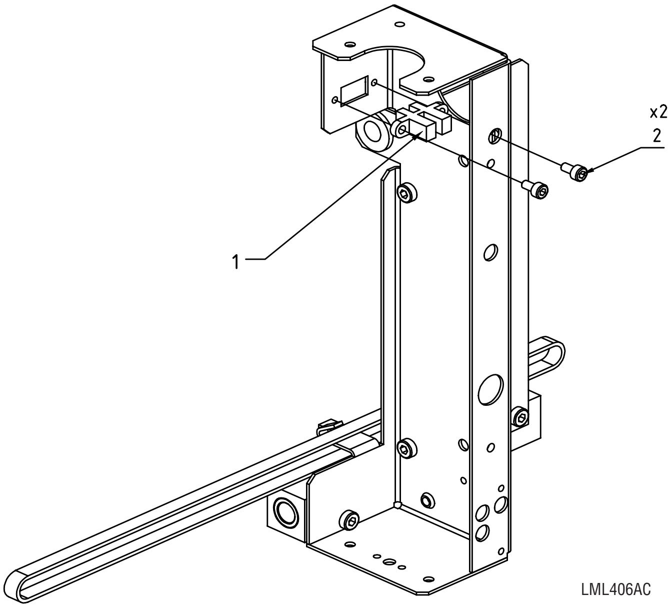

Table 8.2-33 Traverse Vertical Movement Components - Home Sensor (See Figure 8.2-33)

Item	Part Number	Description
1	XBA396A	Sensor, home, sample probe vertical
2	KAA002AA	Screw, hex M3x6

Figure 8.2-34 Traverse Horizontal Movement Components - Motor (See Table 8.2-34)

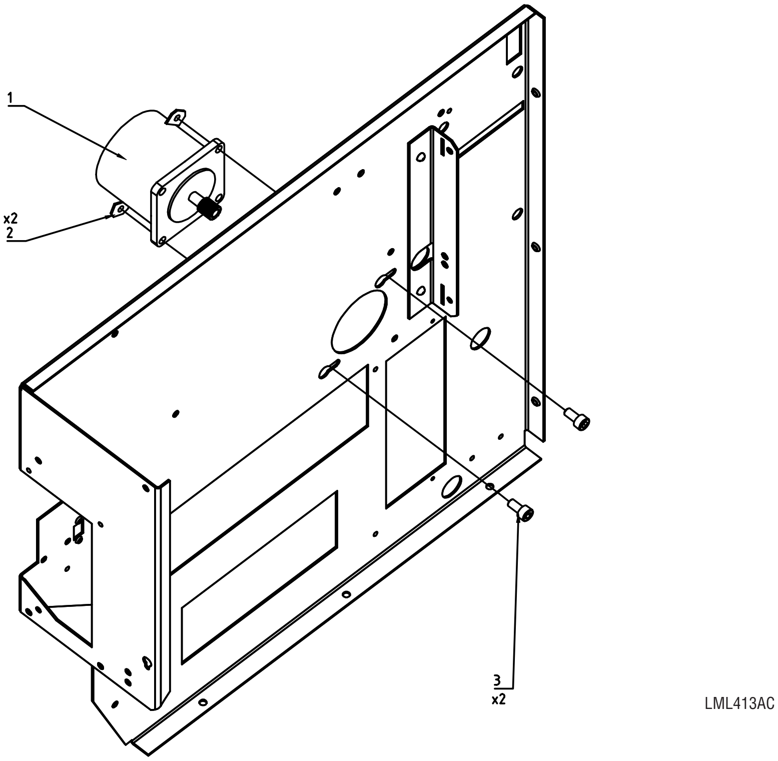

Table 8.2-34 Traverse Horizontal Movement Components - Motor (See Figure 8.2-34)

Item	Part Number	Description
1	XBA391A	Motor, traverse, horizontal
2	GBG095A	Nut, plate M5
3	KAA021A	Screw, hex M5x10

Figure 8.2-35 Traverse Horizontal Movement Components - Belt (See Table 8.2-35)t

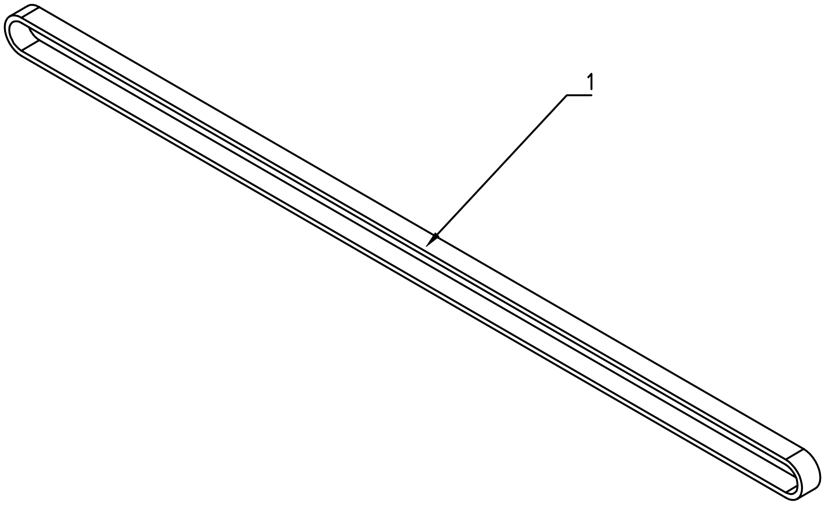

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Table 8.2-35 Traverse Horizontal Movement Components - Belt (See Figure 8.2-35)

Item	Part Number	Description
1	FBR012A	Belt, traverse horizontal, 544 tooth

Figure 8.2-36 Traverse Horizontal Movement Components - Free Wheel and Home Sensor (See Table 8.2-36)

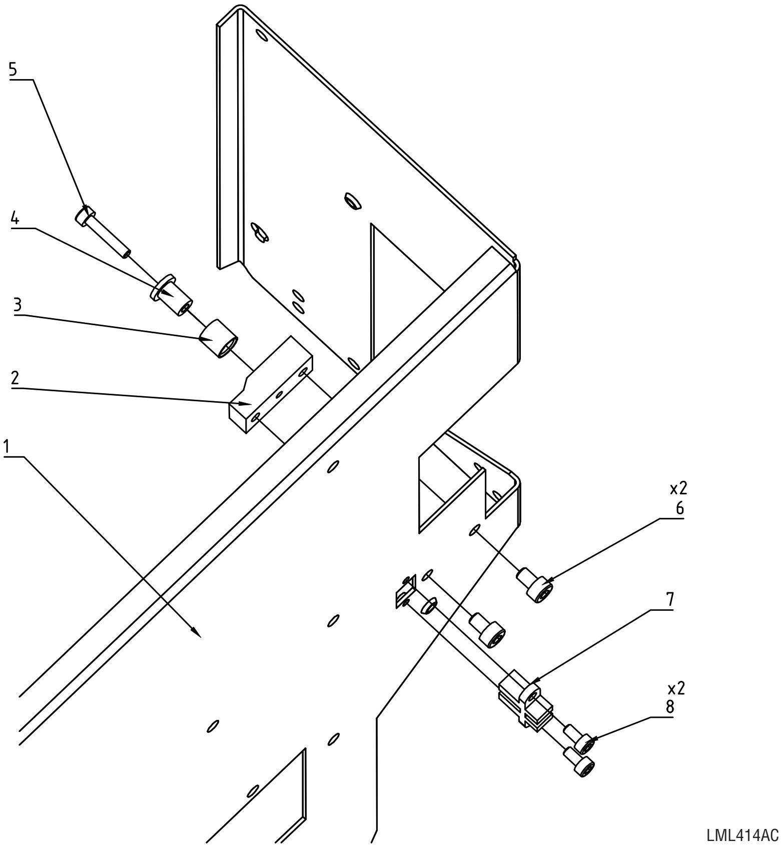

Table 8.2-36 Traverse Horizontal Movement Components - Free Wheel and Home Sensor (See Figure 8.2-36)

Item	Part Number	Description
1		Frame assembly
2	GBG146A	Freewheel strengthener
3	GBG093A	Pulley, belt freewheel
4	FAG011A	Bearing
5	KAA007A	Screw, hex M3x16
6	KAA013A	Screw, hex M4x6
7	XBA394A	Sensor, home, traverse horizontal
8	KAA002A	Screw, hex M3x6

Figure 8.2-37 Optical Bench Assembly (See Table 8.2-37)

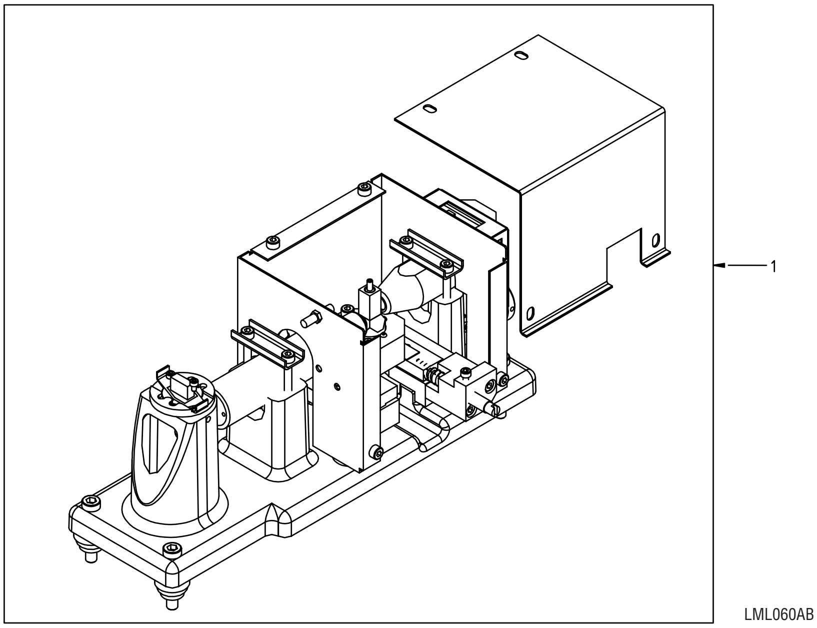

Table 8.2-37 Optical Bench Assembly (See Figure 8.2-37)

Item	Part Number	Description
1	XDA600AS	Optical bench assembly

Figure 8.2-38 Optical Bench Lamp (See Table 8.2-38)

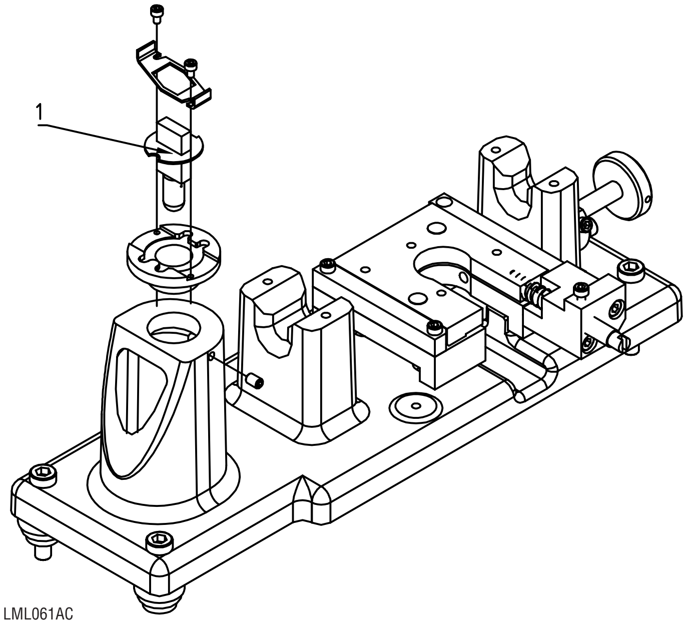

Table 8.2-38 Optical Bench Lamp (See Figure 8.2-38)

Item	Part Number	Description
1	DAJ007A	Optical bench lamp

Figure 8.2-39 DIFF Flow Cell Assembly (See Table 8.2-39)

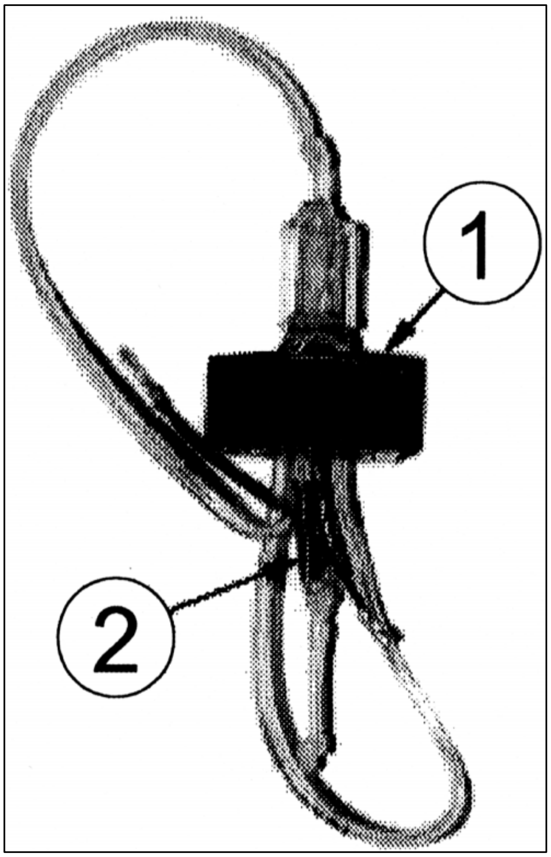

Table 8.2-39 DIFF Flow Cell Assembly (See Figure 8.2-39)

Item	Part Number	Description
1	XDA601AS	Flow cell, assembly
2	XBA403A	Shield, flow cell tubing ground

Figure 8.2-40 Optics Preamplifier (See Table 8.2-40)

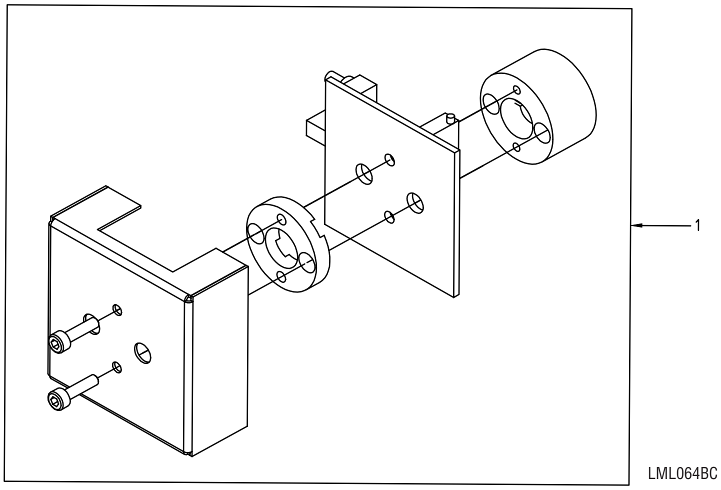

Table 8.2-40 Optics Preamplifier (See Figure 8.2-40)

Item	Part Number	Description
1	XAA423BS	Preamp, optical signal assembly

Figure 8.2-41 LED Card (See Table 8.2-41)

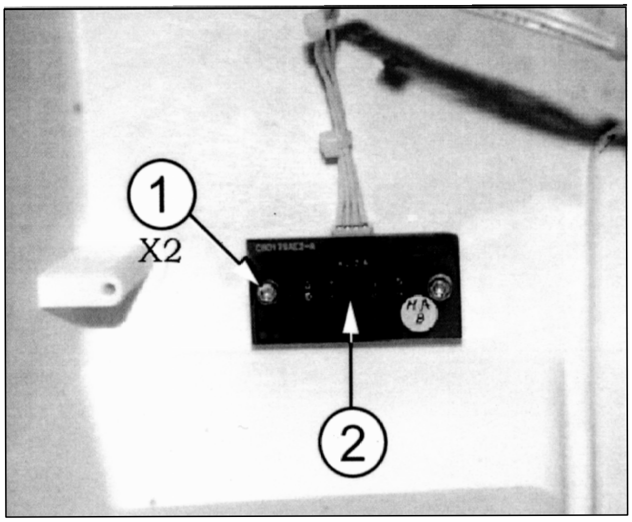

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Table 8.2-41 LED Card (See Figure 8.2-41)

Item	Part Number	Description
1	KZZ022A	Screw, auto-threaded
2	XAA468A	PCB, LED card, aspiration indicator

Figure 8.2-42 Bath Enclosure Compartment (See Table 8.2-42)

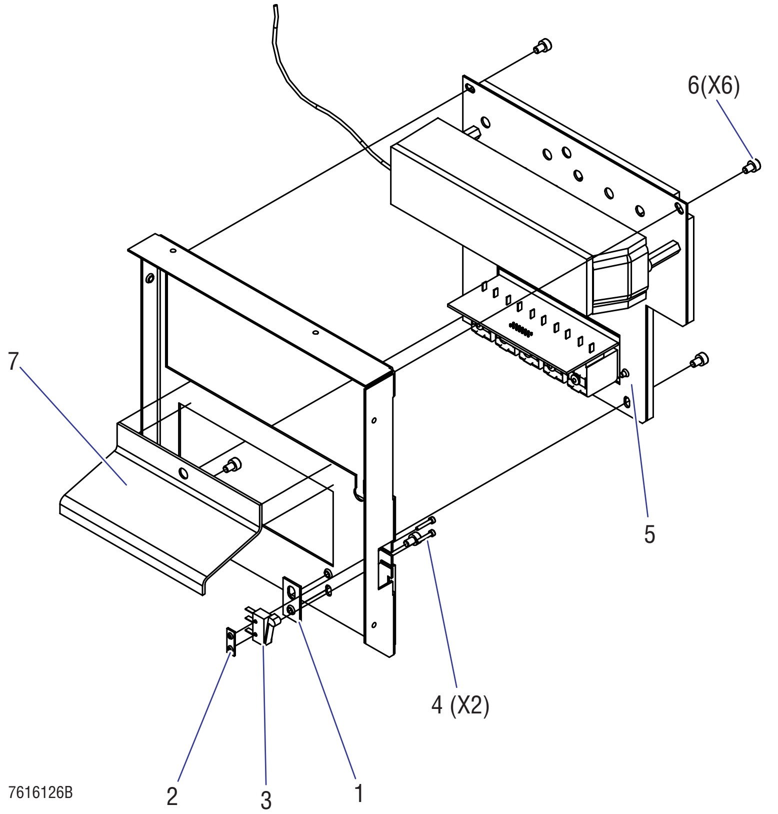

Table 8.2-42 Bath Enclosure Compartment (See Figure 8.2-42)

Item	Part Number	Description
1	GBG020A	Nut, plate, bath enclosure compartment
2	GBD498A	Nut, plate, microswitch
3	CAE006A	Switch, microswitch XC5-81-82
4	KAA041A	Screw, hex M2x12
5	KZZ022A	Screw, auto-threaded
6	KAA013A	Screw, hex M4x6
7	GBG205A	Cover, solenoid drivers, bank 27-31

Figure 8.2-43 Bath Enclosure Fan Assembly (See Table 8.2-43)

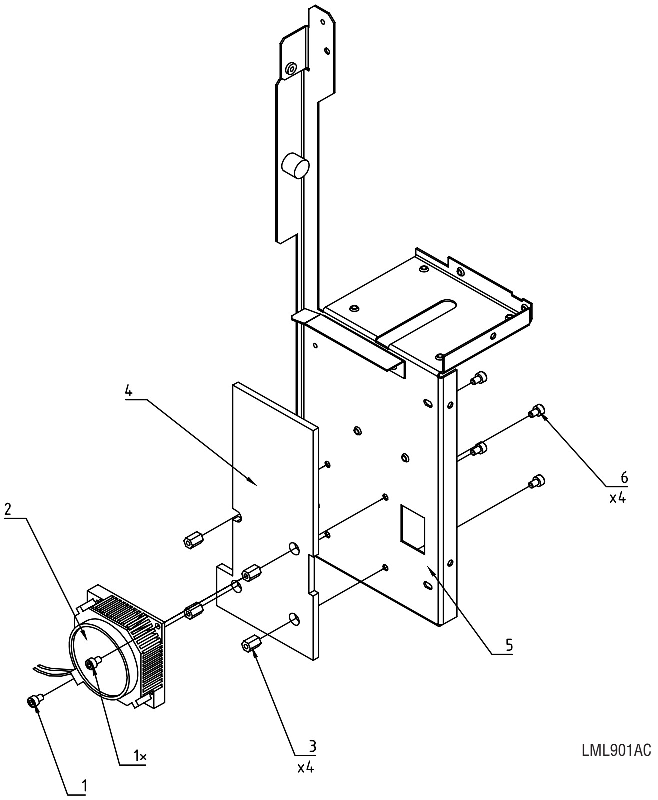

Table 8.2-43 Bath Enclosure Fan Assembly (See Figure 8.2-43)

Item	Part Number	Description
1	KAA013A	Screw, hex M4x6
1x	KAA015A	Screw, hex M4x8
2	XEA487AS	Fan, bath enclosure temperature control
3	KAN023A	Collar
4	GBG019A	Insulated plate
5	GBG063A	Steel
6	KAA013A	Screw, hex M4x6

Figure 8.2-44 Bath Enclosure Door Interlock (See Table 8.2-44)

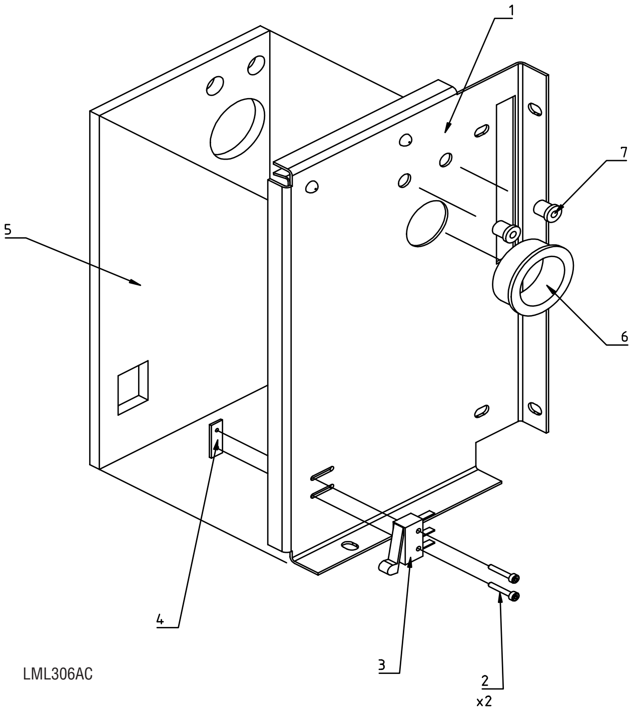

Table 8.2-44 Bath Enclosure Door Interlock (See Figure 8.2-44)

Item	Part Number	Description
1	GBG012A	Backplate, bath enclosure
2	KAA041A	Screw, hex M2x12
3	CAE006A	Switch, microswitch XC5-81-82
4	GBD498A	Nut, microswitch
5	GBG018A	Plate, bath enclosure, rear isolation
6	DBE026A	Thrust
7	FAM006A	Bushing

Figure 8.2-45 Reagent Heating Coil Assembly (See Table 8.2-45)

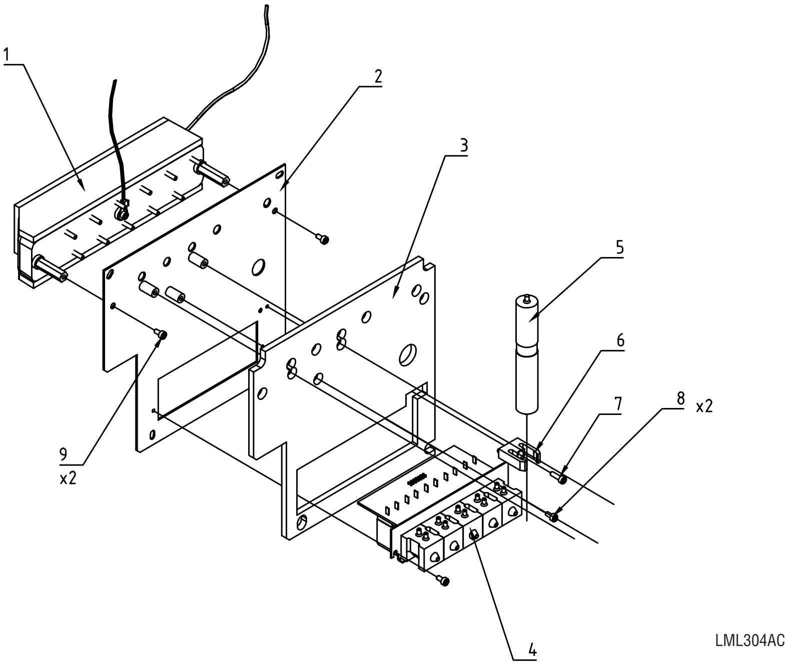

Table 8.2-45 Reagent Heating Coil Assembly (See Figure 8.2-45)

Item	Part Number	Description
1	XDA625AS	Heater, reagent coil assembly
2	GBG009A	Holder clip, chamber
3	GBG014A	Chamber plate, insulated
4	XDA615CS	Valve, liquid, 5-valve assembly (27-31)
5	XCA166A	Chamber, isolator (long)
6	GBC015A	Clip, long isolator chamber holder, package of 10
7	KAA003A	Screw, hex M3x8
8	KAA002A	Screw, hex M3x6
9	KAA013A	Screw, hex M4x6

Figure 8.2-46 Baths Assembly (See Table 8.2-46)

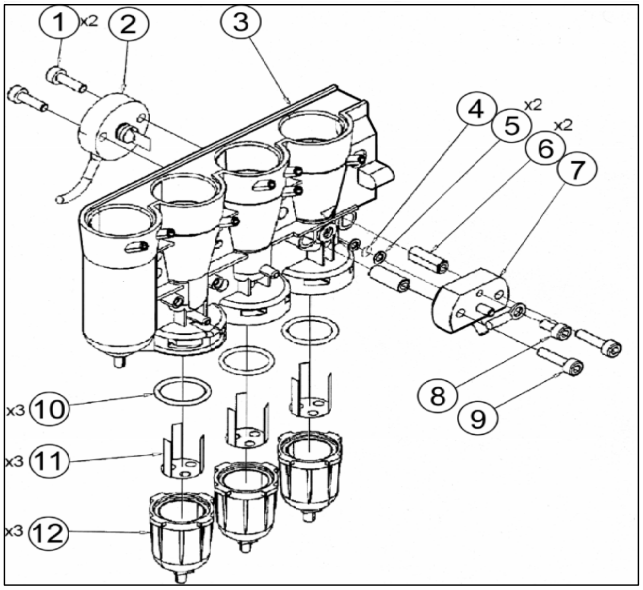

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Table 8.2-46 Baths Assembly (See Figure 8.2-46)

Item	Part Number	Description
1	KAA004A	Screw, hex M3x10
2	XBA398B	Cable, coaxial, with RBC/WBC bath electrode
3	GBG001A	Four-bath unit
4	FAK001A	Aperture, RBC/Plt, 50 µ
5	GBG156A	O-ring, aperture, package of 12
6	GBG004A	Collar
7	GBG157A	Counting head (internal electrode)
8	KAA002A	Screw, hex M3x6
9	KAA005A	Screw, hex M3x12
10	FAA066A	O-ring, bath drain/debubble chamber, package of 12
11	GBG007A	Diffuser, drain and debubble, set of 4
12	GBG003A	Chamber, drain and debubble

Figure 8.2-47 Hgb Photometer Assembly (See Table 8.2-47)

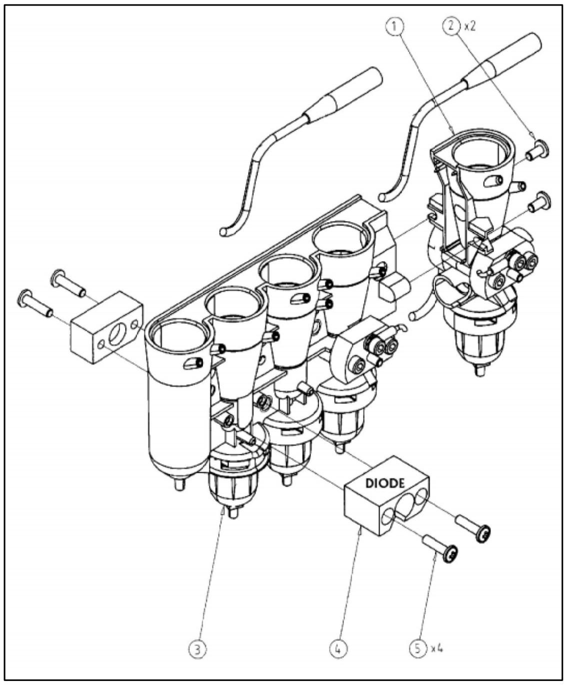

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Table 8.2-47 Hgb Photometer Assembly (See Figure 8.2-47)

Item	Part Number	Description
1	XDA610A	Bath, WBC/BASO
2	KZZ022A	Screw, auto-threaded
3	XDA602A	Bath, assembly, 3-baths and rinse chamber
4	XBA389A	Photometer, Hgb diode and preamp assembly
5	KZZ026A	Screw, auto-threaded

Figure 8.2-48 WBC/BASO Bath Assembly (See Table 8.2-48)

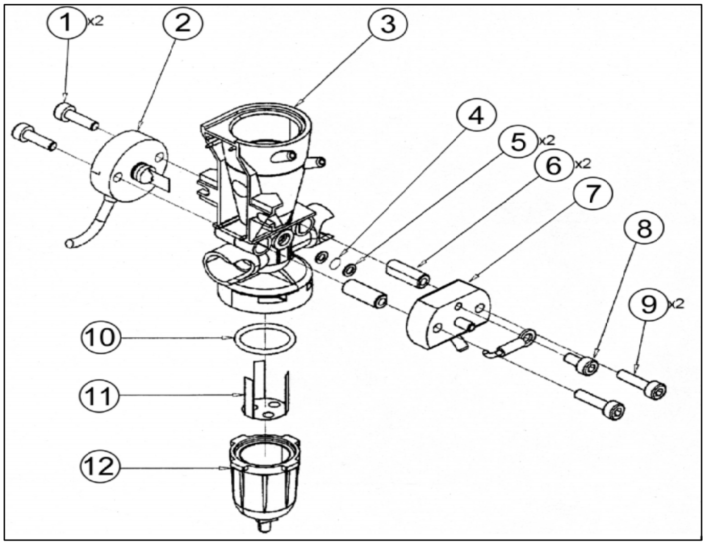

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Table 8.2-48 WBC/BASO Bath Assembly (See Figure 8.2-48)

Item	Part Number	Description
1	KAA004A	Screw, hex M3x10
2	XBA398B	Cable, coaxial, with RBC/WBC bath electrode
3	GBG002A	Bath, WBC/Hgb/BASO
4	FAK003A	Aperture, WBC/BASO, 80 µm
5	GBG156A	O-ring, aperture, package of 12
6	GBG004A	Collar
7	GBG157A	Counting head (internal electrode)
8	KAA002A	Screw, hex M3x6
9	KAA005A	Screw, hex M3x12
10	FAA066A	O-ring, bath drain/debubble chamber, package of 12
11	GBG007A	Diffuser, drain and debubble, set of 4
12	GBG003A	Chamber, drain and debubble

Figure 8.2-49 Rear Frame Assembly (See Table 8.2-49)

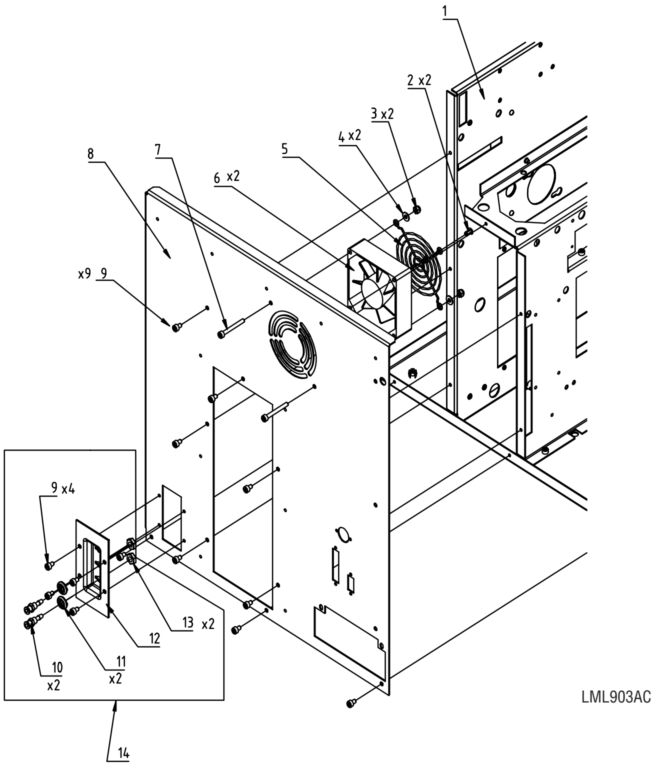

Table 8.2-49 Rear Frame Assembly (Figure 8.2-49)

Item	Part Number	Description
1		Frame assembly
2	DBK021A	Rivets
3	KAH018A	Nut, M4
4	KAJ002A	Washer, M diameter 0.4
5	FAN001A	Fan protector
6	XBA393A	Fan, main chassis, 24V
7	KAA031A	Screw, hex M4x35
8	GBG058A	Plate, rear frame
9	KAA013A	Screw, hex M4x6
10	EAC010A	Fitting, Luer, female, i.d. 3 mm, package of 5
11	EAC008A	Fitting, antirotation washer, package of 5
12	GBG071A	Receptacle
13	KAH024A	Nut 1/4-28 (US std)
14	XDA623AS	Panel, reagent/waste fittings assembly

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A.1-3 Thresholds Voltage Limits, A.1-1
A.1-4 Mixing Bubble Limits, A.1-1
A.1-5 Power Supply Voltages, A.1-2
A.1-6 Whole-Blood Reproducibility CV Limits for 20 Cycles, A.1-2
A.1-7 Calibration Factor Limits, A.1-2
A.2-1 Main Card Test Points , A.2-2
A.2-2 Main Card Potentiometers, A.2-4
A.2-3 Connectors on the Optical Preamplifier Card, A.2-6
A.2-4 Connectors on the Keypad and LCD Card, A.2-7
A.2-5 Connector on the LED Card, A.2-8
A.2-6 Connectors on the Motor Interconnect Card, A.2-9
A.2-7 Connectors on the Traverse Card, A.2-10

A.3-1 Mechanical and Hydraulic Modules, A.3-3
C.1-1 Flag Sensitivity Default Values, C.1-1
C.1-2 WBC/BASO Factory-Set Threshold Values, C.1-3
C.1-3 DiffPlot - Volume Thresholds (Y-Axis), C.1-5
C.1-4 DiffPlot - Absorbance Thresholds (X-Axis), C.1-6
C.1-5 DiffPlot - FNL, FNE, and FMN Thresholds, C.1-7

A.1 TOLERANCE AND LIMITS

Table A.1-1 Flow Cell Adjustment Limits

Parameter	Target Value	Acceptable Range
DIFF LAMP	6.00	5.50 to 6.50
TRANSFER TIME	200	150 to 250
RESISTIVE CHANNEL	50	45 to 55
ABSORBANCE CHANNEL	180	170 to 190

Table A.1-2 Motor Voltage Limits

Motor	Test Point	Voltage	Potentiometer
Waste syringe	TP5	4 V ± 0.05 V	R149
Count syringe	TP6	4 V ± 0.05 V	R150
Dilutor syringe	TP7	4 V ± 0.05 V	R151
Optical bench injector syringe	TP8	3 V ± 0.05 V	R152
Horizontal traverse	TP10	3 V ± 0.05 V	R154
Sample syringe	TP11	2 V ± 0.05 V	R155
Probe carriage	TP12	5 V ± 0.05 V	R156

Table A.1-3 Thresholds Voltage Limits

Threshold	Test Point	Voltage	Potentiometer
BASO	TP14	300 mV ± 5	R157
RBC	TP13	300 mV ± 5	R158
PLT	TP2	300 mV ± 5	R159
LMNE (DIFF) CIS	TP3	650 mV ± 5	R160
LMNE (DIFF) OD	TP4	350 mV ± 5	R161

Table A.1-4 Mixing Bubble Limits

Mixing Bath	Low Limit	Normal	High Limit
FIRST DILUTION	100	300	400
DIFF	100	300	400
WBC/BASO	100	300	400
HGB LYSE	300	400	500

Table A.1-5 Power Supply Voltages

Test Point	Designation	Target Value
TP40	5V Power supply	+5V
TP41	12V Power supply	+12V
TP42	24V Power supply	+24V
TP43	-12V Power supply	-12V

Table A.1-6 Whole-Blood Reproducibility CV Limits for 20 Cycles

Parameters	%CV	Test Level
WBC	<2%	at 10.0 x 10^3 cells / µL
RBC	<2%	at 5.00 x 10^6 cells / µL
Hgb	<1%	at 15.0 g/dL
Hct	<2%	at 45.0%
MCV	<1%	at 90.0 fL
Plt	<5%	at 300 x 10^3 cells / µL

Table A.1-7 Calibration Factor Limits

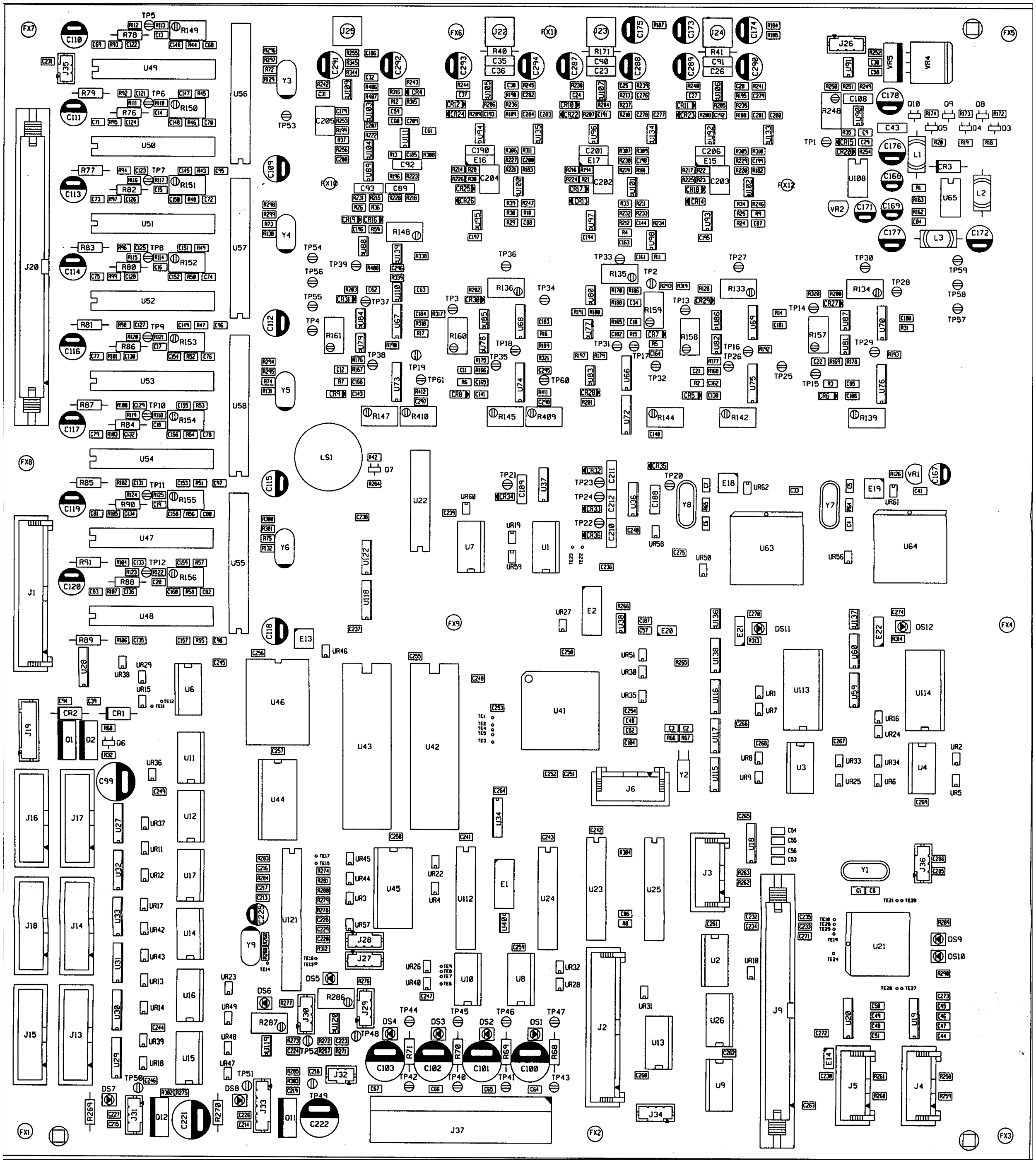
Parameter	Target Value	Minimum Acceptable Value	Maximum Acceptable Value
WBC	137	90	200
RBC	225	160	290
Hgb	40.0	25.0	55.0
Hct	220	160	290
PLT	290	180	400
RDW	0.3	0.1	0.9

A.2 CIRCUIT CARD LAYOUTS WITH KEY COMPONENT DESCRIPTIONS

Main Card

Component Locations

Figure A.2-1 Main Card Components


FX7
FX6
FX11
FX5
FX8
FX10
FX12
FX9
FX4
FX1
FX2
FX3
TP5
R149
R78
C110
J35
U49
R79
TP6
R150
R76
C111
U50
R77
TP7
R151
R82
C113
U51
R83
TP8
R152
R80
C114
J20
U52
R81
TP9
R153
R86
C116
U53
R87
TP10
R154
R84
C117
U54
R85
TP11
R155
R90
C119
U47
R91
TP12
R156
R88
C120
J1
U48
R89
U56
U57
U58
U55
J25
Y3
TP53
C205
C291
C292
C109
C93
C92
C89
R148
Y4
TP54
TP56
TP55
TP4
R161
TP39
TP37
TP38
TP19
TP61
C112
Y5
R147
R410
LS1
Q7
U22
C115
Y6
C118
E13
J22
R40
C35
C36
C293
C294
C190
E16
C204
TP36
R136
TP34
TP3
R160
TP18
TP35
TP60
R145
R409
J23
R171
C90
C23
C287
C288
C201
E17
C202
TP33
R135
TP2
R159
TP31
TP17
TP32
R144
C175
C173
J24
R41
C91
C26
C174
C289
C290
C206
E15
C203
TP27
R133
TP13
R158
TP16
TP26
TP25
R142
J26
VR5
VR4
C178
C108
R248
TP1
C43
C176
L1
Q10
Q9
Q8
Q5
Q4
Q3
C168
U108
R3
U65
L2
VR2
C171
C169
C177
L3
C172
TP30
R134
TP28
TP59
TP58
TP57
TP14
R157
TP29
TP15
R139
TP21
C189
U37
TP23
TP24
TP22
TP20
U36
C188
Y8
E18
UR62
Y7
E19
VR1
C167
UR61
U7
U1
UR60
UR19
UR59
U63
U64
UR58
UR50
UR56
E2
U38
E20
UR27
U136
E21
DS11
U137
E22
DS12
U6
UR38
UR29
UR15
CR2
CR1
J19
Q1
Q2
Q6
U46
U43
U42
U41
UR51
UR30
UR35
U138
U116
U113
U60
U59
U114
UR1
UR7
UR16
UR24
U11
UR36
C99
U44
J6
Y2
U117
U115
U3
U4
UR8
UR9
UR33
UR25
UR34
UR6
UR2
UR5
J16
J17
U27
UR37
U12
U34
U18
U32
UR11
UR12
U17
U45
UR45
UR44
UR3
UR22
UR4
U112
E1
U24
U23
U25
J3
J36
Y1
J18
J14
U33
UR17
UR42
U14
C225
Y9
U121
UR57
J28
J27
U404
U21
DS9
DS10
U31
UR43
UR13
UR23
DS5
UR26
UR40
U10
U8
UR32
UR28
J2
UR31
U2
UR10
J9
J15
J13
U30
UR14
U16
DS6
UR49
UR48
UR47
R287
J30
U120
J29
R286
TP44
DS4
TP45
DS3
TP46
DS2
TP47
DS1
TP48
C103
R71
C102
R70
C101
R69
C100
R68
TP42
TP40
TP41
TP43
U29
UR39
UR18
U15
U119
TP52
U13
U26
U20
U19
E14
J5
J4
TP50
DS7
R269
J31
Q12
C221
R270
DS8
TP51
J33
Q11
J32
TP49
C222
J37
J34
U9
U28
U39
U40
U118
U122

Test Points

Table A.2-1 Main Card Test Points

Test Point	Designation	Potentiometer	Target	Tolerance	Remarks
TP1	HB Gain adjustment	R248	4.7 mV	±0.1 mV	
TP2	PLT Threshold adjustment	R159	300 mV	±5 mV	
TP3	LMNE (DIFF) CIS Threshold adjustment	R160	650 mV	±5 mV	
TP4	LMNE (DIFF) OD Threshold adjustment	R161	350 mV	±5 mV	
TP5	Waste syringe motor	R149	3 V	±50mV	
TP6	Count syringe motor	R150	3 V	±50mV	
TP7	Reagent syringes motor	R151	3 V	±50mV	
TP8	Injection syringe motor	R152	3 V	±50mV	
TP9	Not used				
TP10	Horizontal traverse motor	R154	3 V	±50mV	
TP11	Sample syringe motor	R155	2 V	±50mV	
TP12	Vertical traverse motor	R156	3 V	±50mV	
TP13	RBC Threshold adjustment	R158	300 mV	±5mV	
TP14	BASO Threshold adjustment	R157	300 mV	±5mV	
TP15	BASO Comparator				
TP16	RBC Comparator				
TP17	PLT Comparator				
TP18	LMNE (DIFF) CIS Comparator				
TP19	LMNE (DIFF) OD Comparator				
TP20	RBC line height adjustment	R133	XX V	±50 mV	Factory adjusted
TP21	BASO gain adjustment	R134	XX V	±50 mV	Factory adjusted
TP22	PLT line height adjustment	R135	XX V	±50 mV	Factory adjusted
TP23	DIFF Resistive gain adjustment	R136	XX V	±50 mV	Factory adjusted
TP24	DIFF Optical gain adjustment	R148	XX V	±50 mV	Factory adjusted
TP25	RBC line width adjustment				
TP26	RBC line reject adjustment	R142	10 µs	±0.5 µs	Factory adjusted
TP27	RBC line pulse adjustment				
TP28	BASO line width adjustment				
TP29	BASO line reject adjustment	R139	10 µs	±0.5 µs	Factory adjusted
TP30	BASO line pulse adjustment				
TP31	PLT line width adjustment				
TP32	PLT line reject adjustment	R144	10 µs	±0.5 µs	Factory adjusted
TP33	PLT line pulse adjustment				
TP34	DIFF Resistive line width adjustment				

Table A.2-1 Main Card Test Points *(Continued)*

Test Point	Designation	Potentiometer	Target	Tolerance	Remarks
TP35	DIFF Resistive line reject adjustment	R145	15 µs	±0.5 µs	Factory adjusted
TP36	DIFF Resistive line pulse adjustment				
TP37	DIFF Optical line width adjustment				
TP38	DIFF Optical line reject adjustment	R147	5 µs	±0.5 µs	Factory adjusted
TP39	DIFF Optical line pulse adjustment				
TP40	5V Power supply		5 V		
TP41	12V Power supply		12 V		
TP42	24V Power supply		24 V		
TP43	-12V Power supply		-12 V		
TP44	GROUND				
TP45	GROUND				
TP46	GROUND				
TP47	GROUND				
TP48	Waste sensor	R286	<1 V		With water
TP49	Not used				
TP50	Reagent heating system temperature voltage				
TP51	Thermostated room heating system temperature voltage				
TP52	DIFF drain sensor	R287	<1 V		With water
TP53	DIFF Lamp	R11	6 V		
TP54	GROUND				
TP55	GROUND				
TP56	GROUND				
TP57	GROUND				
TP58	GROUND				
TP59	GROUND				
TP60	DIFF Resistive line reject2 adjustment	R409	50µs	±2 µs	Factory adjusted
TP61	DIFF Resistive line reject2 adjustment	R410	250µs	±5 µs	Factory adjusted

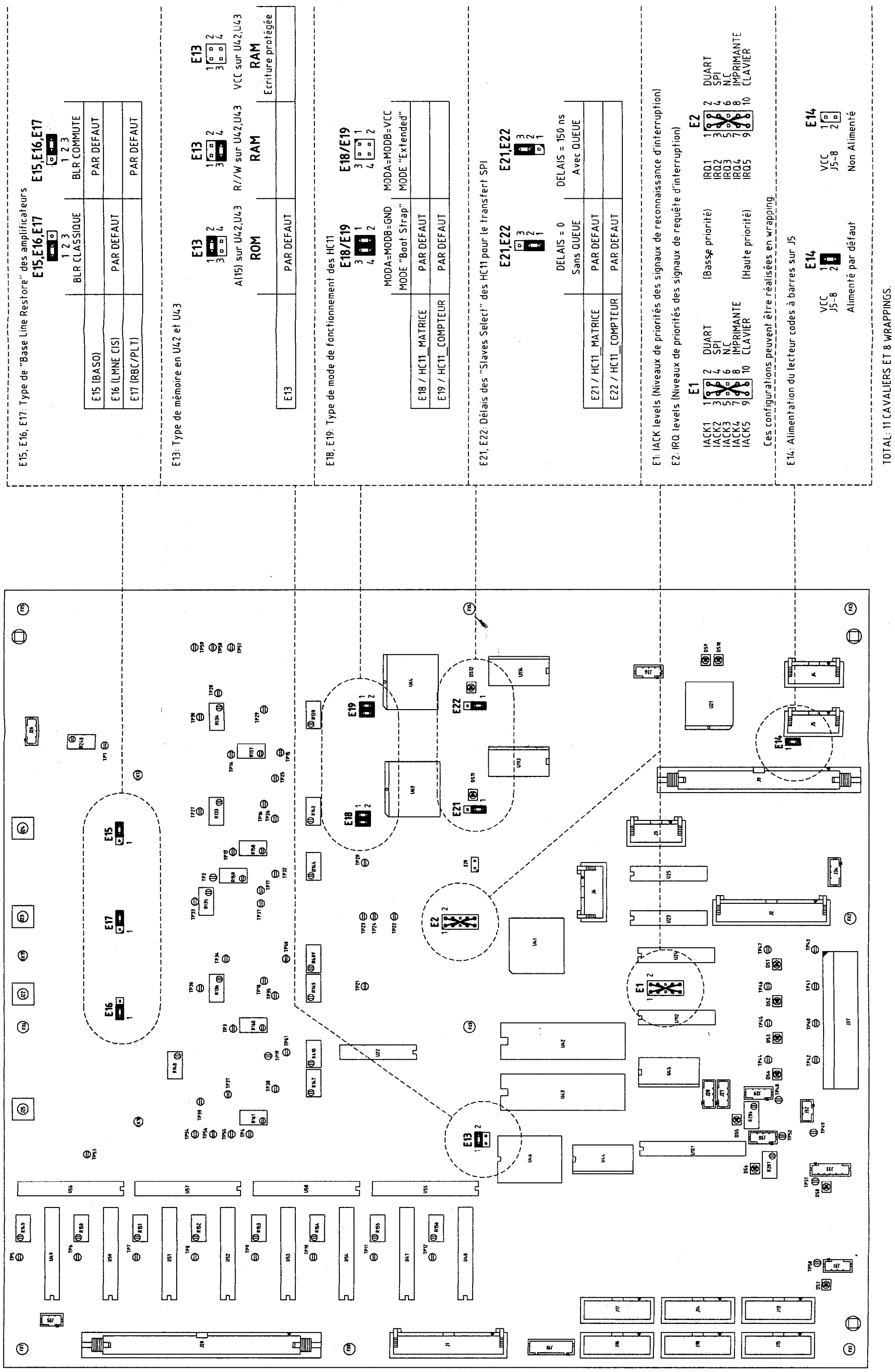
Potentiometers

Table A.2-2 Main Card Potentiometers

Potentiometer	Designation	Test Point	Target	Tolerance	Remarks
R133	RBC line height adjustment	TP20			Factory adjusted
R134	BASO gain adjustment	TP21			Factory adjusted
R135	PLT line height adjustment	TP22			Factory adjusted
R136	DIFF Resistive gain adjustment	TP23			Factory adjusted
R139	BASO line reject adjustment	TP29			Factory adjusted
R142	RBC line reject adjustment	TP26			Factory adjusted
R144	PLT line reject adjustment	TP32			Factory adjusted
R145	DIFF Resistive line reject adjustment	TP35			Factory adjusted
R147	DIFF Optical line reject adjustment	TP38			Factory adjusted
R148	DIFF Optical gain adjustment	TP24			Factory adjusted
R149	Waste syringe motor	TP5	3 V	±50 mV	
R150	Count syringe motor	TP6	3 V	±50 mV	
R151	Reagent syringes motor	TP7	3 V	±50 mV	
R152	Injection syringe motor	TP8	3 V	±50 mV	
R154	Horizontal traverse motor	TP10	3 V	±50 mV	
R155	Sample syringe motor	TP11	2 V	±50 mV	
R156	Vertical traverse motor	TP12	3 V	±50 mV	
R157	BASO Threshold adjustment	TP14	300 mV	±5 mV	
R158	RBC Threshold adjustment	TP13	300 mV	±5 mV	
R159	PLT Threshold adjustment	TP2	300 mV	±5 mV	
R160	LMNE (DIFF) CIS Threshold adjustment	TP3	650 mV	±5 mV	
R161	LMNE (DIFF) OD Threshold adjustment	TP4	350 mV	±5 mV	
R248	HB Gain adjustment	TP1	4.7 mV	±0.1 mV	

Jumper Settings

Figure A.2-2 Main Card Jumper Settings

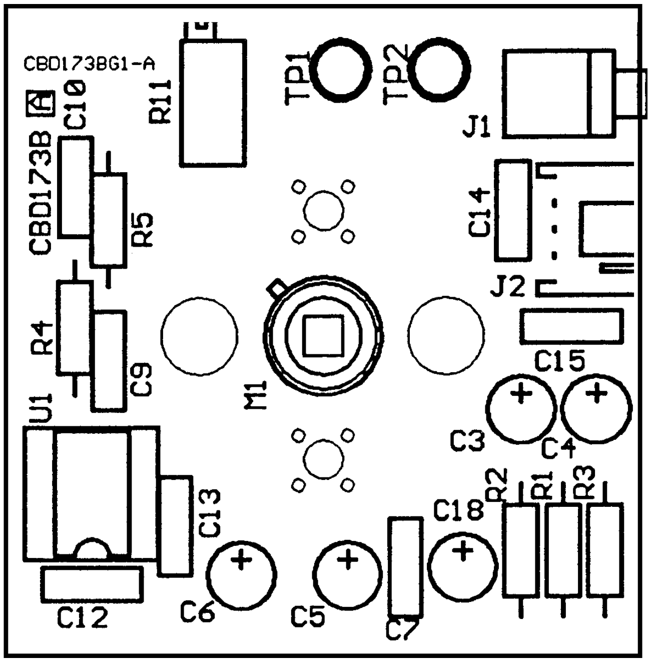

E15, E16, E17: Type de "Base Line Restore" des amplificateurs
E15,E16,E17
1 2 3
BLR CLASSIQUE
BLR COMMUTE
E15 (BASO)
E16 (LMNE CIS)
E17 (RBC/PLT)
PAR DEFAUT
E13: Type de mémoire en U42 et U43
E13
A(15) sur U42,U43
ROM
R//W sur U42,U43
RAM
VCC sur U42,U43
RAM
Ecriture protégée
E18, E19: Type de mode de fonctionnement des HC11
E18/E19
MODA=MODB=GND
MODE "Boot Strap"
MODA=MODB=VCC
MODE "Extended"
E18 / HC11_MATRICE
E19 / HC11_COMPTEUR
E21, E22: Délais des "Slaves Select" des HC11 pour le transfert SPI
E21,E22
DELAIS = 0
Sans QUEUE
DELAIS = 150 ns
Avec QUEUE
E21 / HC11_MATRICE
E22 / HC11_COMPTEUR
E1: IACK levels (Niveaux de priorités des signaux de reconnaissance d'interruption)
E2: IRQ levels (Niveaux de priorités des signaux de requête d'interruption)
E1
IACK1 IACK2 IACK3 IACK4 IACK5
DUART SPI N.C IMPRIMANTE CLAVIER
(Basse priorité)
(Haute priorité)
E2
IRQ1 IRQ2 IRQ3 IRQ4 IRQ5
DUART SPI N.C IMPRIMANTE CLAVIER
Ces configurations peuvent être réalisées en wrapping.
E14: Alimentation du lecteur codes à barres sur J5
E14
VCC
J5-8
Alimenté par défaut
Non Alimenté
TOTAL: 11 CAVALIERS ET 8 WRAPPINGS.
E16
E17
E15
E18
E19
E21
E22
E13
E2
E1
E14

Note: If you have an initialization problem with the 68HC11 Microcontrolers, remove the E20 jumper to reset A^C•T 5diff analyzer. (The instrument must be turned ON).

Optical Preamplifier Card

Component Locations

Figure A.2-3 Optical Preamplifier Card Components


CBD173BG1-A
CBD173B A
C10
R11
TP1
TP2
J1
C14
J2
R5
R4
C9
M1
C15
C3
C4
U1
C13
R2
R1
R3
C18
C12
C6
C5
C7

Connectors

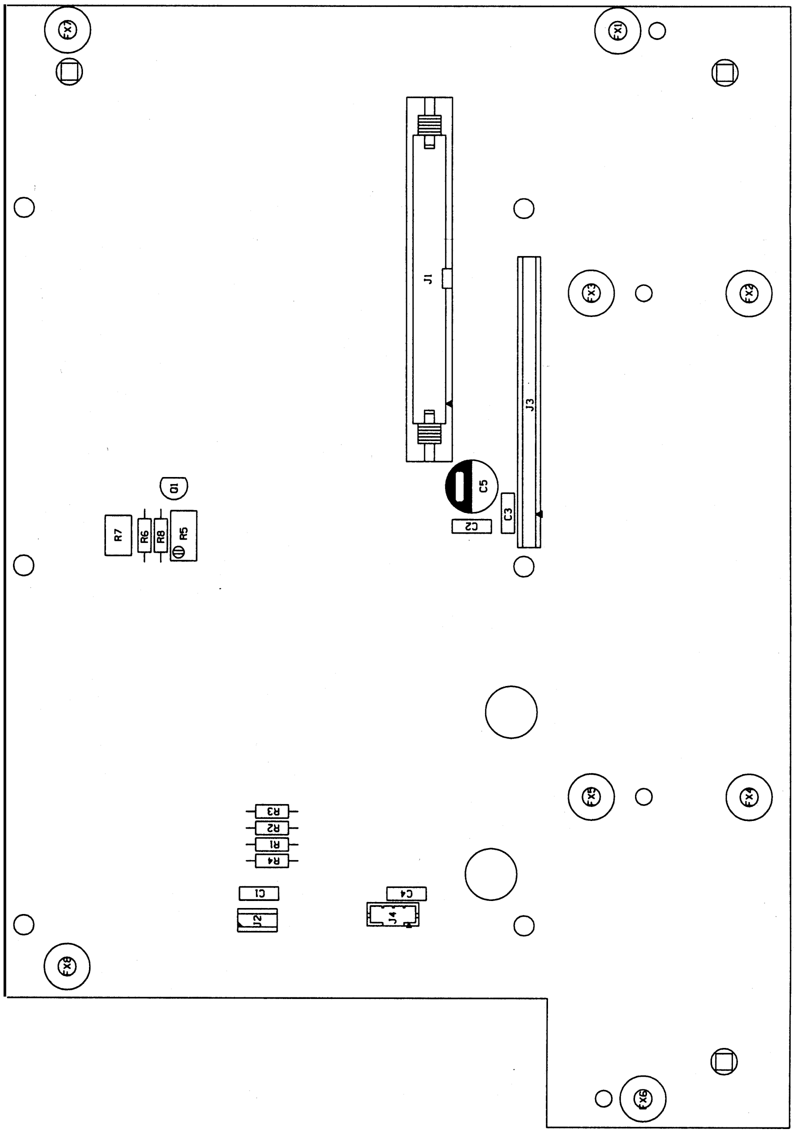
Table A.2-3 Connectors on the Optical Preamplifier Card

Card Label	Description
J1	Optical output signal
J2	Power to card

LCD and Keypad Card

Component Locations

Figure A.2-4 Keypad and LCD Card Components


FX7
FX1
J1
J3
FX3
FX2
Q1
C5
C3
C2
R7
R6
R8
R5
FX5
FX4
R3
R2
R1
R4
C1
C4
J2
J4
FX8
FX6

Connectors

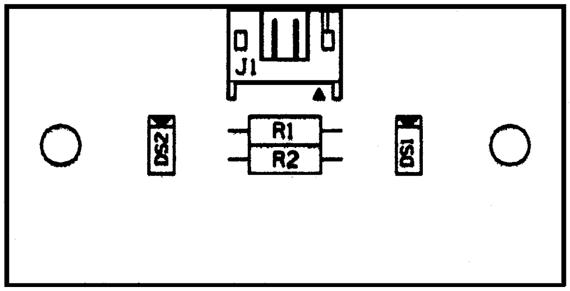
Table A.2-4 Connectors on the Keypad and LCD Card

Card Label	Description
J1	Main interface to main card
J2	Backlight power to LCD
J3	Data out to LCD
J4	Power to aspirate indicator card

LED Card

Component Locations

Figure A.2-5 LED Card Components



Connectors

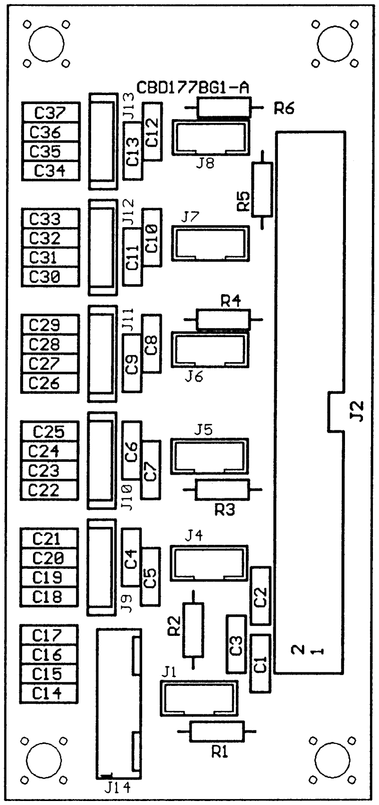
Table A.2-5 Connector on the LED Card

Card Label	Description
J1	Power/signal to LEDs

Motor Interconnect Card

Component Locations

Figure A.2-6 Motor Interconnect Card Components


CBD177BG1-A
C37
C36
C35
C34
J13
C13
C12
J8
R6
R5
C33
C32
C31
C30
J12
C11
C10
J7
R4
C29
C28
C27
C26
J11
C9
C8
J6
J2
C25
C24
C23
C22
J10
C6
C7
J5
R3
C21
C20
C19
C18
J9
C4
C5
J4
C2
R2
C3
C1
2
1
C17
C16
C15
C14
J1
R1
J14

Connectors

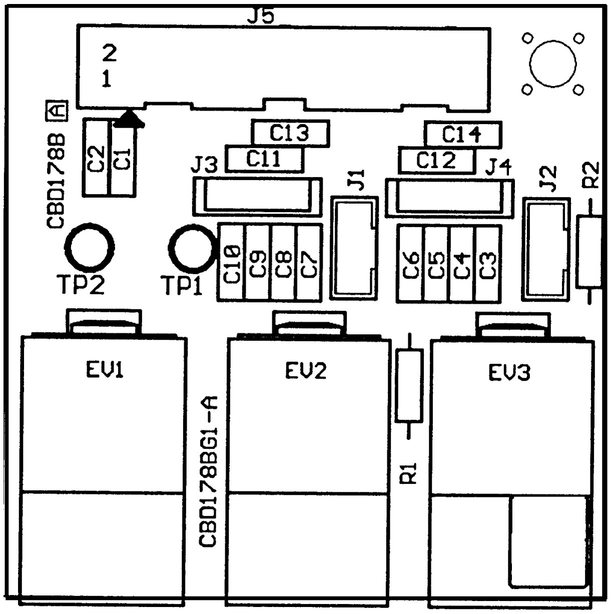
Table A.2-6 Connectors on the Motor Interconnect Card

Card Label	Description
J1	Traverse horizontal home sensor
J2	Power/signals from Main card
J4	Float sensor
J5	Injector syringe home switch
J6	Reagent syringe home switch
J7	Count syringe home switch
J8	Waste syringe home switch
J9	Not used
J10	Injector syringe motor
J11	Reagent syringe motor
J12	Count syringe motor
J13	Waste syringe motor
J14	Traverse horizontal motor

Traverse Card

Component Locations

Figure A.2-7 Traverse Card Components


J5
2
1
CBD178B A
C2
C1
C13
C11
J3
J1
C14
C12
J4
J2
R2
TP2
TP1
C10
C9
C8
C7
C6
C5
C4
C3
EV1
EV2
EV3
CBD178BG1-A
R1

Connectors

Table A.2-7 Connectors on the Traverse Card

Card Label	Description
J1	Traverse vertical motor
J2	Sample syringe home switch
J3	Traverse vertical home sensor
J4	Sample syringe motor
J5	Power/interface to Main card

A.3 A^C•T 5diff MODULE LOCATIONS AND FUNCTIONS

Overview

Most functions are accomplished by fluidic components that are interconnected by tubing and controlled by timed solenoid signals. This section briefly describes the functions of these fluidic components and shows their locations.

Analyzer Modules

The A^C•T 5diff hematology analyzer consists of nine mechanical and hydraulic modules. These modules are identified on Table A.3-1. A description of the module's primary functions is also included. Figures A.3-1 and A.3-2 show each module's location inside the instrument.

Mechanical and Hydraulic Modules Locations

Figure A.3-1 View of an AC•T 5diff Hematology Analyzer with the Right Side Door Open

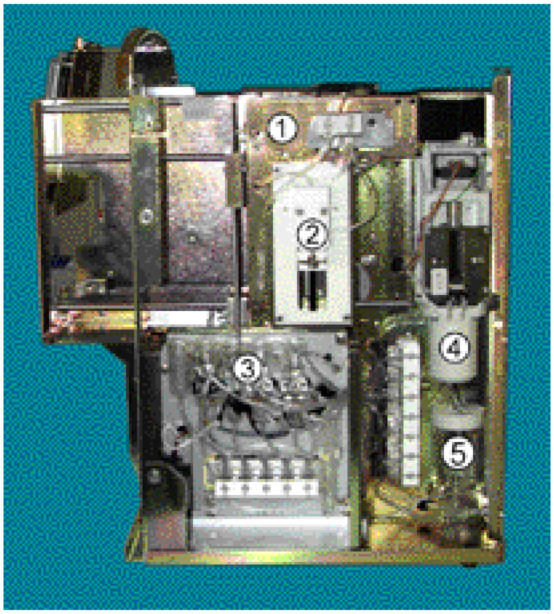


Figure A.3-2 View of an AC•T 5diff Hematology Analyzer with the Left Side Panel Removed

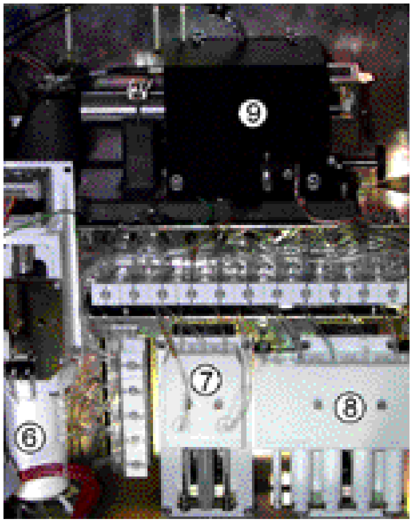


Table A.3-1 Mechanical and Hydraulic Modules

Figure Reference	Module	Functions
Figure A.3-1, 1	Traverse Assembly	• Ensures sample probe positioning for the different sample stages and distribution. • Supports the sample syringe and the distribution of the blood.
Figure A.3-1, 2	Sample Syringe Assembly	• Takes the sample and distributes the portions into the different baths. • Removes a sample from the first dilution (made in the DIL1/HGB bath) and dispenses it into the RBC bath.
Figure A.3-1, 3	Baths Assembly inside the Bath Enclosure	• Receives the different rinsing and dilutions. • Ensures the temperature control of the dilutions. • Ensures the counts for WBC, BASO, RBC, Plt, and Hct. • Ensures Hgb determination.
Figure A.3-1, 4	Waste Syringe	• Drains the different baths. • Provides mixing bubbles to the mixtures. • Provides the vacuum needed to pull the DIFF specimen from the DIFF bath towards the flow cell injector.
Figure A.3-2, 5	Diluent Reservoir	• Holds the diluent needed for an analysis cycle. • Eliminates the risk of diluent degassing as it is being aspirated by the syringes. **Note:** Reservoir is vacuum filled by the count syringe.
Figure A.3-1, 6	Count Syringe	• Provides the vacuum needed for the WBC and the BASO counts. • Provides the vacuum needed for the RBC and PLT counts. • Provides the vacuum needed for filling the diluent reservoir.
Figure A.3-2, 7	5diff Syringe Assembly	• Ensures correct proportioning of the stop diluent in the DIFF preparation bath. • Injects the sample into the flow cell. • Injects the interior and exterior gains into the flow cell.
Figure A.3-2, 8	Reagent Syringes Assembly	• Ensures the correct distribution of the different reagents including: ▸ Lysing agent for hemoglobin (A^C•T 5diff Hgb Lyse). ▸ Cleaning reagent (A^C•T 5diff Rinse). ▸ Lysing agent for the DIFF (A^C•T 5diff Fix). ▸ Diluent used for the dilutions (A^C•T 5diff Diluent) except the DIFF stop diluent. ▸ Lysing agent for WBC/BASO (A^C•T 5diff WBC Lyse).
Figure A.3-2, 9	Optical Bench Assembly	• Provides support and ensures adjustment of the flow cell. • Provides support and ensures adjustment of the optics lamp. • Provides support and ensures adjustment of the optical and electronic elements.

Rear Panel

Figure A.3-3 Rear Panel - A^{C}•T 5diff Hematology Analyzer

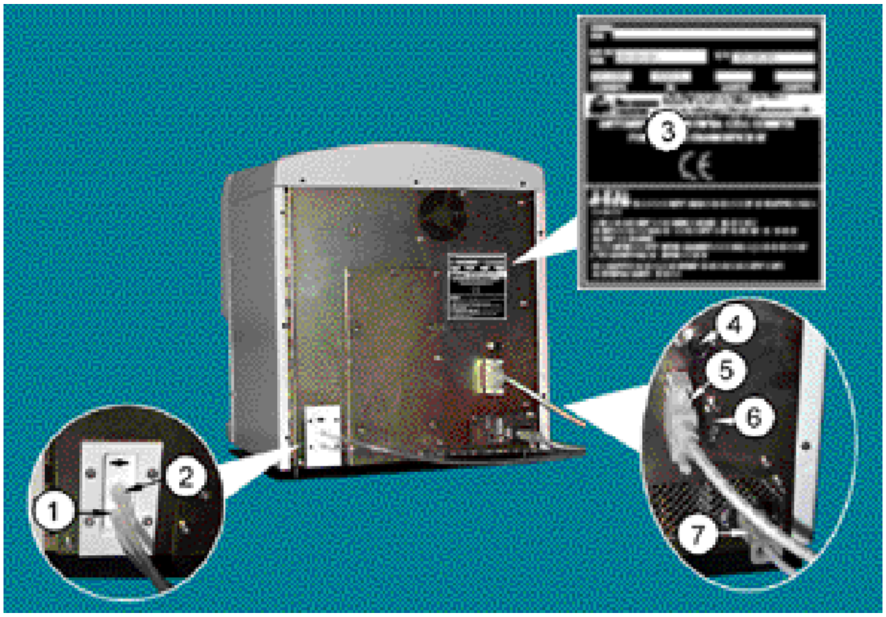
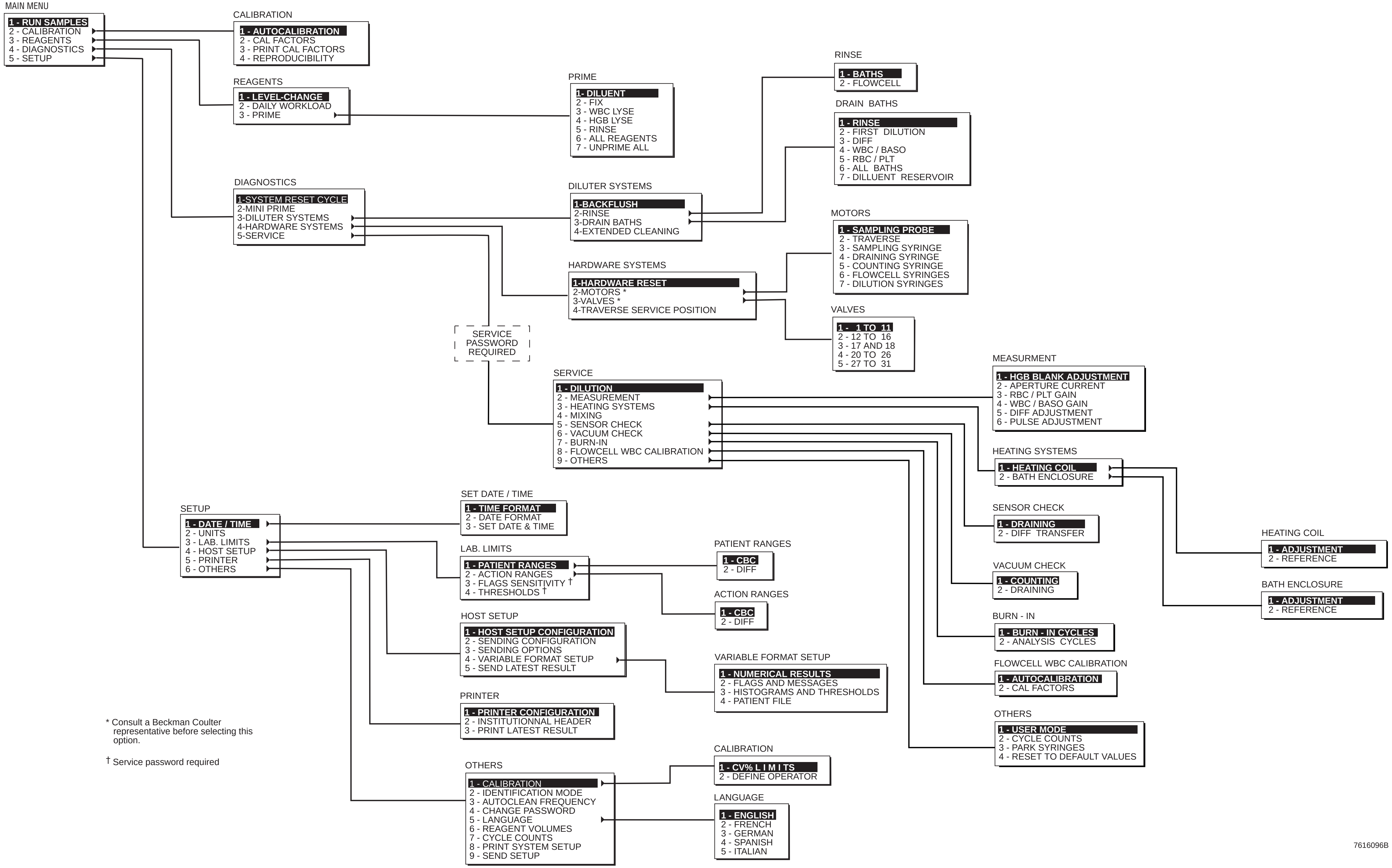


Figure Reference	Attachments to the Rear Panel
Figure A.3-3, 1	Waste output
Figure A.3-3, 2	Diluent input
Figure A.3-3, 3	Serial number label
Figure A.3-3, 4	Bar-code reader connector
Figure A.3-3, 5	Printer connector
Figure A.3-3, 6	RS232C output
Figure A.3-3, 7	Power cord

A.4 SOFTWARE MENU TREE

Figure A.4-1 Software Menu Tree


MAIN MENU
1 - RUN SAMPLES
2 - CALIBRATION
3 - REAGENTS
4 - DIAGNOSTICS
5 - SETUP
CALIBRATION
1 - AUTOCALIBRATION
2 - CAL FACTORS
3 - PRINT CAL FACTORS
4 - REPRODUCIBILITY
REAGENTS
1 - LEVEL-CHANGE
2 - DAILY WORKLOAD
3 - PRIME
PRIME
1 - DILUENT
2 - FIX
3 - WBC LYSE
4 - HGB LYSE
5 - RINSE
6 - ALL REAGENTS
7 - UNPRIME ALL
RINSE
1 - BATHS
2 - FLOWCELL
DRAIN BATHS
1 - RINSE
2 - FIRST DILUTION
3 - DIFF
4 - WBC / BASO
5 - RBC / PLT
6 - ALL BATHS
7 - DILLUENT RESERVOIR
DIAGNOSTICS
1-SYSTEM RESET CYCLE
2-MINI PRIME
3-DILUTER SYSTEMS
4-HARDWARE SYSTEMS
5-SERVICE
DILUTER SYSTEMS
1-BACKFLUSH
2-RINSE
3-DRAIN BATHS
4-EXTENDED CLEANING
MOTORS
1 - SAMPLING PROBE
2 - TRAVERSE
3 - SAMPLING SYRINGE
4 - DRAINING SYRINGE
5 - COUNTING SYRINGE
6 - FLOWCELL SYRINGES
7 - DILUTION SYRINGES
HARDWARE SYSTEMS
1-HARDWARE RESET
2-MOTORS *
3-VALVES *
4-TRAVERSE SERVICE POSITION
VALVES
1 - 1 TO 11
2 - 12 TO 16
3 - 17 AND 18
4 - 20 TO 26
5 - 27 TO 31
SERVICE PASSWORD REQUIRED
SERVICE
1 - DILUTION
2 - MEASUREMENT
3 - HEATING SYSTEMS
4 - MIXING
5 - SENSOR CHECK
6 - VACUUM CHECK
7 - BURN-IN
8 - FLOWCELL WBC CALIBRATION
9 - OTHERS
MEASURMENT
1 - HGB BLANK ADJUSTMENT
2 - APERTURE CURRENT
3 - RBC / PLT GAIN
4 - WBC / BASO GAIN
5 - DIFF ADJUSTMENT
6 - PULSE ADJUSTMENT
HEATING SYSTEMS
1 - HEATING COIL
2 - BATH ENCLOSURE
SENSOR CHECK
1 - DRAINING
2 - DIFF TRANSFER
VACUUM CHECK
1 - COUNTING
2 - DRAINING
BURN - IN
1 - BURN - IN CYCLES
2 - ANALYSIS CYCLES
FLOWCELL WBC CALIBRATION
1 - AUTOCALIBRATION
2 - CAL FACTORS
OTHERS
1 - USER MODE
2 - CYCLE COUNTS
3 - PARK SYRINGES
4 - RESET TO DEFAULT VALUES
HEATING COIL
1 - ADJUSTMENT
2 - REFERENCE
BATH ENCLOSURE
1 - ADJUSTMENT
2 - REFERENCE
SETUP
1 - DATE / TIME
2 - UNITS
3 - LAB. LIMITS
4 - HOST SETUP
5 - PRINTER
6 - OTHERS
SET DATE / TIME
1 - TIME FORMAT
2 - DATE FORMAT
3 - SET DATE & TIME
LAB. LIMITS
1 - PATIENT RANGES
2 - ACTION RANGES
3 - FLAGS SENSITIVITY †
4 - THRESHOLDS †
PATIENT RANGES
1 - CBC
2 - DIFF
ACTION RANGES
1 - CBC
2 - DIFF
HOST SETUP
1 - HOST SETUP CONFIGURATION
2 - SENDING CONFIGURATION
3 - SENDING OPTIONS
4 - VARIABLE FORMAT SETUP
5 - SEND LATEST RESULT
VARIABLE FORMAT SETUP
1 - NUMERICAL RESULTS
2 - FLAGS AND MESSAGES
3 - HISTOGRAMS AND THRESHOLDS
4 - PATIENT FILE
PRINTER
1 - PRINTER CONFIGURATION
2 - INSTITUTIONNAL HEADER
3 - PRINT LATEST RESULT
OTHERS
1 - CALIBRATION
2 - IDENTIFICATION MODE
3 - AUTOCLEAN FREQUENCY
4 - CHANGE PASSWORD
5 - LANGUAGE
6 - REAGENT VOLUMES
7 - CYCLE COUNTS
8 - PRINT SYSTEM SETUP
9 - SEND SETUP
CALIBRATION
1 - CV% L I M I TS
2 - DEFINE OPERATOR
LANGUAGE
1 - ENGLISH
2 - FRENCH
3 - GERMAN
4 - SPANISH
5 - ITALIAN
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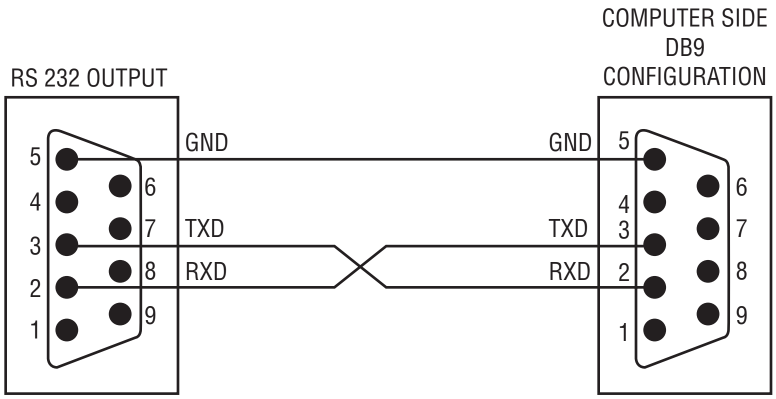
* Consult a Beckman Coulter representative before selecting this option.

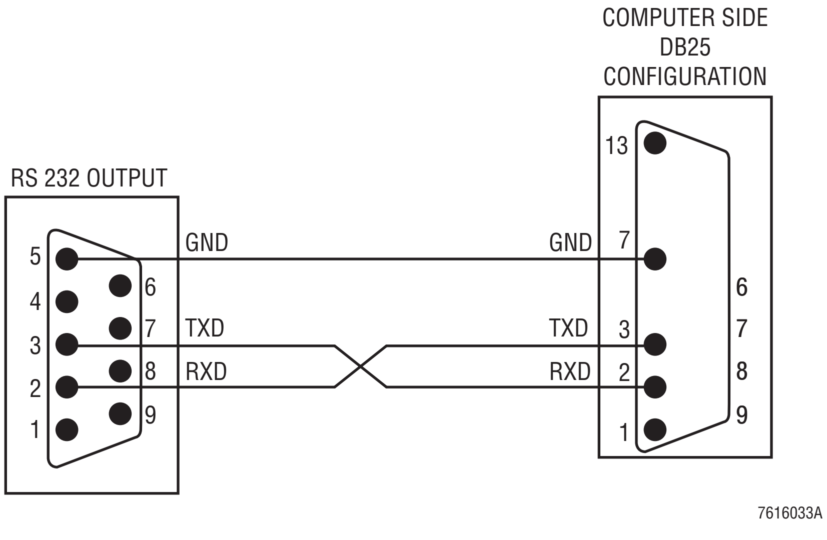
† Service password required

B.1 FORMAT

See Host Transmission Specification PN 4277065A.

B.2 PACKET TYPE PIN ASSIGNMENTS


COMPUTER SIDE
DB9
CONFIGURATION
RS 232 OUTPUT
5
4
3
2
1
6
7
8
9
GND
TXD
RXD
GND
TXD
RXD
5
4
3
2
1
6
7
8
9


COMPUTER SIDE
DB25
CONFIGURATION
RS 232 OUTPUT
5
4
3
2
1
6
7
8
9
GND
TXD
RXD
GND
TXD
RXD
13
7
3
2
1
6
7
8
9
7616033A

C.1 OVERVIEW

The instrument flags a sample if its results exceed specific criteria defined within the software.

The values used to position the thresholds, which separate different cell populations and determine if a flag should be triggered, are selected to provide optimal population separation and flagging under normal operating conditions.

The software provides you with the ability to modify the values used to position the thresholds between populations and to alter the level at which a flag associated with a population is triggered.

Changing any of the values that define threshold positions or changing the flag sensitivity values from the default values will alter the parameter values reported and whether or not a flag is associated with a result.

Flag Sensitivity

A result outside the flag sensitivity range triggers a flag to appear with the parameter result. The flag occurs if either the percentage or absolute count value is exceeded.

You can adjust a flag's sensitivity for percentage and/or absolute number. Table C.1-1 shows the flag sensitivity default values.

Table C.1-1 Flag Sensitivity Default Values

Flag Region	Percentage of Cells	Absolute Number of Cells
DB (Debris)	100	120
SL (Small Lymphocytes)	100	50
SL1 (Small Lymphocytes 1)	5	45
NL (Neutrophil / Lymphocyte)	3	120
MN (Monocyte / Neutrophil)	100	120
UM (Upper Monocyte)	1.1	999
LN (Lower Neutrophil)	2.5	999
UN (Upper Neutrophil)	1.1	999
NE (Neutrophil / Eosinophil)	1.1	60
ATL (Atypical Lymphocytes)	2	200
*WBC	3.5	999
MICRO (Microcytes)	5*	Not applicable
MACRO (Macrocytes)	7.5*	Not applicable
Hgb M	3.0%	Not applicable
Hgb B	Not applicable	60 (A to D units)

Note: Hgb M - defines the allowable difference between the three readings taken on the sample.
Hgb B - defines the allowable difference between the reference blank and sample blank.

* MICRO and MACRO flags are activated in software version 1.03 and higher.

- For a definition of each flag, see Chapter 6 of the Operator’s Guide.
- If you need to change a flag sensitivity value, use the procedure under Heading C.2.

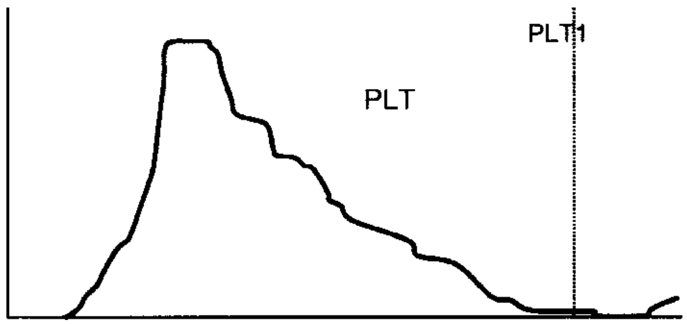
Thresholds

The values used to position the thresholds, which separate different cell populations and determine if a flag should be triggered, are selected to provide optimal population separation and flagging under normal operating conditions.

Plt Threshold

The PLT threshold (PLT 1) is the number of the last channel used to calculate the platelet count (Figure C.1-1). The factory setting for the Plt threshold is 197.

Figure C.1-1 PLT Threshold

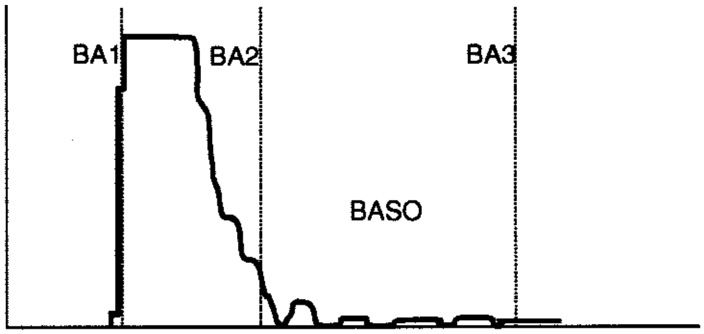


If you must change the platelet threshold, use the procedure under Heading C.3. However, be aware that changing this value from the default value will alter parameter values reported and whether or not those results are flagged.

WBC and BASO Thresholds

Differentiation between basophils and other leukocytes is obtained by means of the A^C•T 5diff WBC Lyse-specific lytic action. Thresholds BA1, BA2, and BA3 allow the determination of the basophil population in relationship to the total number of white blood cells (Figure C.1-2).

Figure C.1-2 WBC and BASO Threshold



In Figure C.1-2, all leukocytes are shown between the BA1 and BA3 thresholds. *WBC absolute value is calculated between channel 0 and the BA1 threshold.

The percentage of basophils is calculated according to the number of particles from the BA2 threshold to the BA3 threshold. These thresholds are factory-set to the values shown in Table C.1-2.

Table C.1-2 WBC/BASO Factory-Set Threshold Values

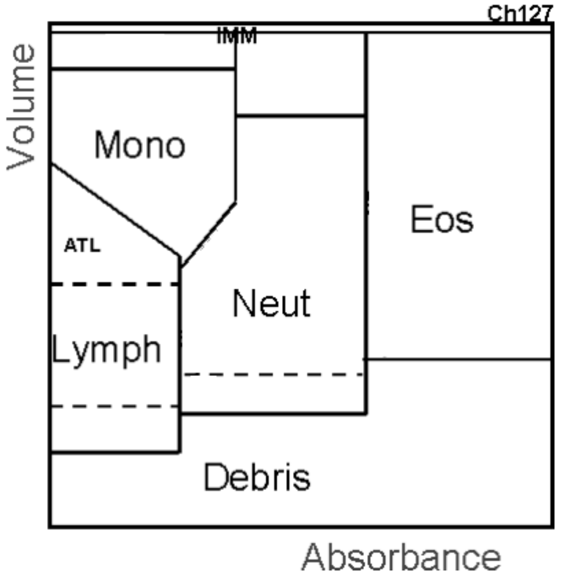
Threshold	Purpose	Channel
0	*WBC # counting area	0
BA1	Separation threshold between the *WBC # counting area and the WBC	35
BA2	Separation threshold between the WBC and basophils	110
BA3	End of the basophil counting area	240

If you must change the BA1, BA2, and BA3 thresholds, use the procedure under Heading C.3. However, be aware that changing these values from the default values will alter the parameter values reported and whether or not those results are flagged.

DiffPlot Thresholds

On the DiffPlot, both the X-axis and Y-axis are divided into 128 channels, numbered from 0 to 127 (Figure C.1-3).

Figure C.1-3 DiffPlot



Although invisible, there are 13 vertical grids on the DiffPlot's X-axis and 13 horizontal grids on the Y-axis. These grids form channels that can be located and given numbers. The origin or first location is Channel 0, at the bottom left corner. The fourth location of the DiffPlot is channel 30, and so forth. Threshold adjustment is expressed in channels.

Adjustment of the thresholds may be considered to:

- Improve the separation between different cell populations that may vary according to the anti-coagulant used or the instrument's internal adjustment.
- Modify the flag areas to improve detection sensitivity. You must also readjust the value of the respective flags.
- Modify one or several DiffPlot regions to precisely define a specific population for research purposes.

There are three categories of threshold adjustment limits:

- Volume thresholds on the Y-axis.
- Absorbance thresholds on the X-axis.
- FNL, FNE, FMN thresholds which indicate the width of the channel in the NL, NE, and MN alarm areas.

DiffPlot - Volume Thresholds

The volume thresholds on the Y-axis are identified in Figure C.1-4 and explained in Table C.1-3.

Figure C.1-4 DiffPlot - Volume Thresholds (Y-axis)

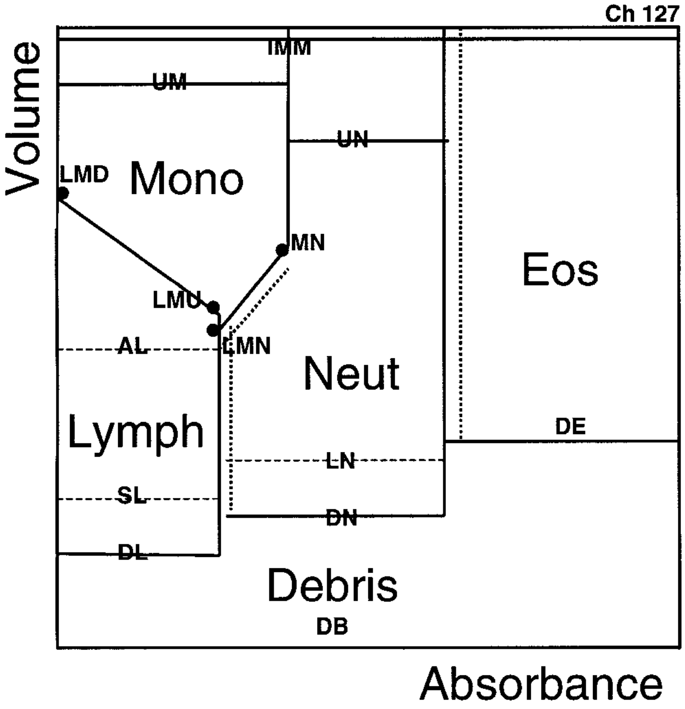


Table C.1-3 DiffPlot - Volume Thresholds (Y-Axis)

Threshold	Purpose	Default Channel	Low Limit	High Limit
DL	Separates debris and small lymphocytes.	22	0	SL
DN	Separates debris and lower neutrophils.	25	DL	DE
SL	Separate lower lymphocytes and lymphocytes.	30	NL	AL
LN	Separates neutrophils and small neutrophils.	35	DN	LMN
DE	Separates debris and eosinophils.	48	DN	Channel 127
LMN	Intersection point between the LY, MO, and NE thresholds.	70	LN	LMU
AL	Separates lymphocytes and atypical lymphocytes.	68	SL	LMU
LMU	Lower dot on the separation slope between atypical lymphocytes and monocytes.	78	AL	LMD
LMD	Upper dot on the separation slope between atypical lymphocytes and monocytes.	90	LMU	UM
MN	Upper dot on the separation slope between monocytes and neutrophils.	90	LMN	UM
UM	Separates monocytes and upper monocytes.	118	LMD	Channel 127
UN	Separates neutrophils and upper neutrophils.	118	MN	Channel 127

DiffPlot - Absorbance Thresholds

The absorbance thresholds on the X-axis are identified in Figure C.1-5 and explained in Table C.1-4.

Figure C.1-5 DiffPlot - Absorbance Thresholds (X-Axis)

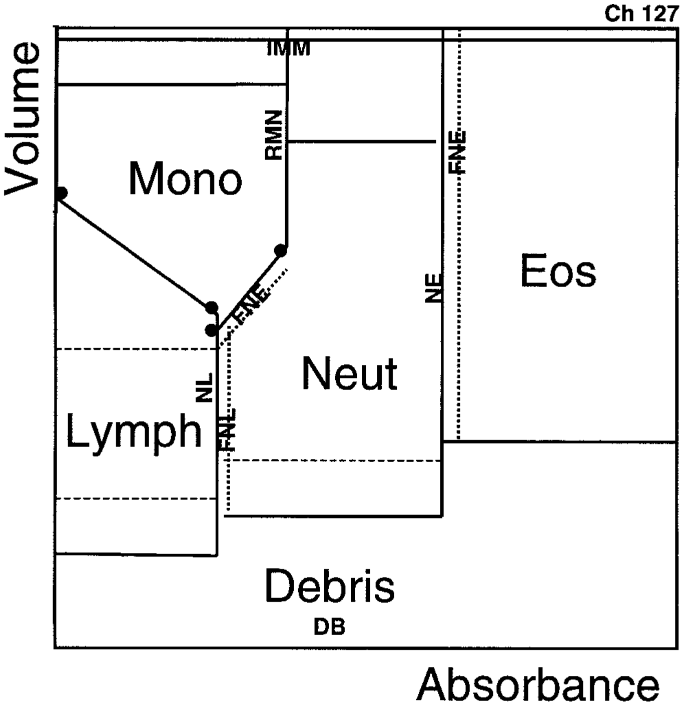

Ch 127
IMM
RMN
FNE
Volume
Mono
Eos
NE
FNE
Neut
NL
Lymph
FNL
Debris
DB
Absorbance

Table C.1-4 DiffPlot - Absorbance Thresholds (X-Axis)

Thresholds	Purpose	Default Channel	Low Limit	High Limit
NL	Separates lymphocytes and neutrophils.	29	0	RMN
RMN	Separates upper monocytes and upper neutrophils.	51	NL	NE
NE	Separates neutrophils and eosinophils.	78	RMN	Channel 127

NL, NE, and MN Alarms

FNL, FNE, FMN thresholds indicate the width in channel of the NL, NE, and MN alarm areas. The alarms are identified in Figure C.1-5 and explained in Table C.1-5.

Table C.1-5 DiffPlot - FNL, FNE, and FMN Thresholds

Threshold	Purpose	Default Channel
FNL	Channel number for the NL alarm region.	2
FNE	Channel number for the NE alarm region.	2
FMN	Channel number for the MN alarm region.	2

RBC Histogram

RDI (Red Cell Distribution Index) threshold indicates the width in channel numbers of the RBC1 and RBC2 thresholds used in MICRO and MACRO calculation. The default value is 12.2.

C.2 SETTING FLAG SENSITIVITY

Purpose

IMPORTANT Risk of inaccurate flagging. Use extreme caution when doing this procedure, flag sensitivity settings are typically not changed from the factory default settings.

It is strongly recommended that **no changes** be made to the default values. Changing the flag sensitivity values from the default values will alter whether or not a flag will be associated with a result.

Use this procedure only if changing the flag sensitivity values is absolutely necessary. You may also use this procedure to re-enter the flag sensitivity default values listed in Table C.1-1.

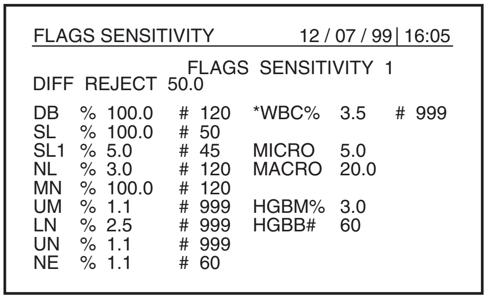
Tools/Supplies Needed

- ☐ Service password (If needed, see Service Password under Heading 4.1.)

Procedure

1. From the Main menu, select **SETUP** ▸▸ **LAB. LIMITS** ▸▸ **FLAGS SENSITIVITY**. The *SERVICE PASSWORD* prompt appears.
2. At the instrument keypad, press the numeric keys correlating to the Service password then press **ENTER**. The Flags Sensitivity screen appears (Figure C.2-1).

Figure C.2-1 Flags Sensitivity Screen



```
FLAGS SENSITIVITY            12 / 07 / 99| 16:05

                     FLAGS  SENSITIVITY  1
DIFF  REJECT  50.0

DB   %  100.0   #  120   *WBC%   3.5    #  999
SL   %  100.0   #  50
SL1  %  5.0     #  45    MICRO   5.0
NL   %  3.0     #  120   MACRO   20.0
MN   %  100.0   #  120
UM   %  1.1     #  999   HGBM%   3.0
LN   %  2.5     #  999   HGBB#   60
UN   %  1.1     #  999
NE   %  1.1     #  60
```

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3. Move the cursor to the value to be changed.
4. Edit the value using the numeric keypad.
5. Press **ENTER** to accept the new value and move to the next field.
6. Repeat steps 3 through 5 as needed to change additional values.
7. Select the next range and repeat steps 3 through 7 as required.
8. When all changes are completed, press **ESC** as many times as necessary to return to the Main Menu.

Verification

Run several normal and abnormal whole-blood specimens to verify the results are accurate with proper flagging, as applicable.

C.3 SETTING THRESHOLDS

Purpose

IMPORTANT Risk of inaccurate results. Use extreme caution when doing this procedure, threshold settings are typically not changed from the factory default settings.

It is strongly recommended that **no changes** be made to the default values. By changing the thresholds, you are altering the populations. Therefore, changing any of the values that define threshold positions will ultimately alter the parameter values reported and whether or not a flag is associated with a result.

Use this procedure only if changing the threshold values is absolutely necessary. You may also use this procedure to re-enter the threshold default values listed in Appendix C:

- Table C.1-2, WBC/BASO Factory-Set Threshold Values
- Table C.1-3, DiffPlot - Volume Thresholds (Y-Axis)
- Table C.1-4, DiffPlot - Absorbance Thresholds (X-Axis)
- Table C.1-5, DiffPlot - FNL, FNE, and FMN Thresholds

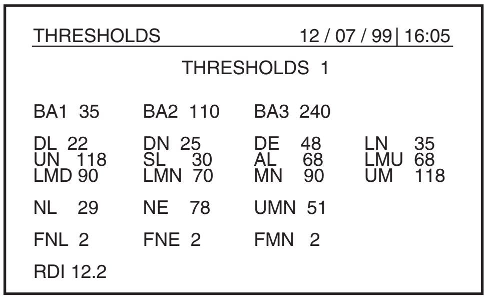
Tools/Supplies Needed

☐ Service password (If needed, see Service Password under Heading 4.1.)

Procedure

1. From the Main menu, select **SETUP ▸▸ LAB. LIMITS ▸▸ THRESHOLDS**. The *SERVICE PASSWORD* prompt appears.
2. At the instrument keypad, press the numeric keys correlating to the Service password then press **ENTER**. The Thresholds screen appears (Figure C.3-1).

Figure C.3-1 Thresholds Screen



```
THRESHOLDS                12 / 07 / 99| 16:05
               THRESHOLDS 1

BA1  35      BA2  110     BA3  240

DL  22       DN  25       DE    48      LN    35
UN   118     SL     30    AL    68      LMU  68
LMD 90       LMN  70      MN    90      UM    118

NL    29     NE    78     UMN  51

FNL  2       FNE  2       FMN   2

RDI 12.2
```

3. Move the cursor to the value to be changed.
4. Edit the value using the numeric keypad.
5. Press **ENTER** to accept the new value and move to the next field.
6. Repeat steps 3 through 5 as needed to change additional values.
7. Select the next range and repeat steps 3 through 7 as required.
8. When all changes are completed, press **ESC** as many times as necessary to return to the Main Menu.

Verification

Run several normal and abnormal whole-blood specimens to verify the results are accurate with proper flagging, as applicable.

ABBREVIATIONS, ABBREVIATIONS-1

The following list is a composite of the abbreviations, acronyms and reference designators used in this manual. When the same abbreviation (or reference designator) is used for more than one word (or type of component), all meanings relevant to this manual are included, separated by semicolons.

SYMBOLS

°C - degrees Celsius
°F - degrees Fahrenheit
> - greater than
≥ - greater than or equal to
< - less than
≤ - less than or equal to
µA - micro amperes
µL - microliters
µs - microseconds
- - minus
% - percent
+ - plus
± - plus or minus

A

ac - alternating current
ATL - atypical lymphocytes

B

BA - basophil

C

cm - centimeters
CTN -
CV - coefficient of variant; check valve

D

dc - direct current
DB - debris
Dil - diluent
DVM - digital voltmeter
DFF - dual focused flow

E

ESD - electrostatic discharge
EV -
EOS - eosinophil

F

F - fuse
fL - femtoliters
ft - feet

G

g - grams
g/dL - grams per deciliter

H

Hct - hematocrit
Hg - mercury
Hgb -hemoglobin
Hz - hertz

I

i.d. - internal diameter
in. - inches
in. Hg - inches of mercury
I/O - input/output
IMM - immature cell

J

J - receptacle connector

K

K - kilos
KΩ - kilohms
KHz - kilohertz

L

LCD - liquid crystal display
LED - light emitting diode

LN - lower neutrophil
LYMPH -lymphocyte

M

MΩ - megohms
M - motor
mA - milli-amperes
max - maximum
MB - megabytes
MACRO - macrocytes
MCH - mean cell hemoglobin
MCHC - mean cell hemoglobin concentration
MCV - mean corpuscle volume
MICRO - microcytes
MN - monocyte/neutrophil)
MONO - monocyte
MHz - megahertz
mb - millibars
mL - milliliters
mm - millimeters
mN.m - milliNewton meter

N

NE - neutrophil /eosinophil)
NEUT - neutrophil
NL - neutrophil /lymphocyte
nm - nanometers

O

o.d. - outside diameter
ozf.in - ounce force inch

P

P - plug connector
PC - printed circuit
PCB - printed circuit board
Plt - platelet count
PN - part number
ppm - pages per minute

Q

QA - quality assurance
QC - quality control

R

R - resistor
RAM - random access memory
RBC - red blood cell count
RDW - red cell distribution width
RF - reference
RH - relative humidity
RN - resistor
ROM - read only memory
RPWV - red pulse-width value
RS-232 - Electronic Industries Association standard governing interface between data processing and data communications equipment

S

S - switch; solenoid
SLO-BLO - slow blow
SW - switch
SL - small lymphocytes
SL1 - small lymphocytes 1

T

Temp - temperature
TP - test point

U

UM - upper monocyte
UN - upper neutrophil

V

V - volts
Vac - vacuum; volts alternating current
Vdc - volts direct current

W

W - watt

WBC - white blood cell count
WM - wire marker
WMCV - white mean corpuscle value
WPWV - white pulse-width voltage

X

X - jumper; plugged
x - times

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